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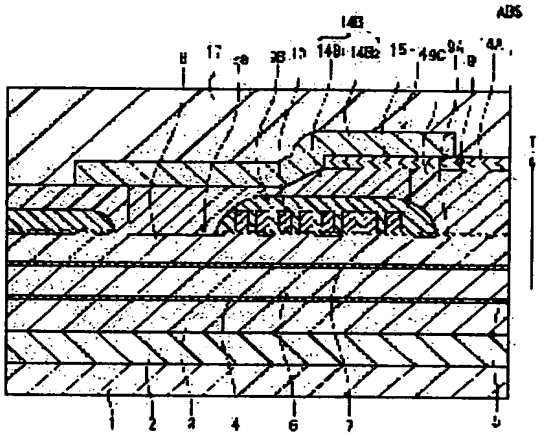
## (54) THIN FILM MAGNETIC HEAD AND MANUFACTURING METHOD THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance the magnetic field in the direction perpendicular to the surface of a recording medium, generated from a magnetic pole part and to shorten the magnetic path length to enhance high frequency characteristics in a thin film magnetic head.
SOLUTION: A thin film magnetic head is provided with a first and a second magnetic layers 8 and 14 each including a magnetic pole part and magnetically connected with each other at a position apart from a medium facing surface ABS, a gap layer 9 provided between the magnetic layers 8 and 14 and a thin film coil 10, a part of which is provided between the magnetic layers 8 and 14. The second magnetic layer 14 has a magnetic pole part layer 14A and a yoke part layer 14B. The saturated magnetic flux density of the magnetic pole part layer 14A is higher than the saturated magnetic flux density of the yoke part layer 14B. The yoke part layer 14B comprises a first layer 14B1 coming in contact with the surfaces on the gap layer 9 side of the first magnetic layer 8 and the magnetic pole part layer 14A and a second layer 14B2 coming into contact with the first layer 14B1 and both side surfaces of the rear end surface and the width direction of the magnetic pole part layer 14A.



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* NOTICES *



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CLAIMS

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[Claim(s)]
[Claim 1] While the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium is included The 1st and 2nd magnetic layers each other magnetically connected in the location distant from said medium opposed face, At least the gap layer which consisted of a non-magnetic material and was prepared between said 1st magnetic layer and 2nd magnetic layer, and a part between said 1st and 2nd magnetic layers It is the thin film magnetic head equipped with the thin film coil prepared in the condition of having insulated to said 1st and 2nd magnetic layers. The field by the side of the a part of [ at least ] 2nd [ of said thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of said gap layer in a medium opposed face ] magnetic layer. Said 2nd magnetic layer The magnetic pole partial layer as which the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects magnetically said magnetic pole part and said 1st magnetic layer. The saturation magnetic flux density of said magnetic pole partial layer It is the thin film magnetic head characterized by being more than the saturation magnetic flux density of said yoke partial layer, and connecting [ in / at least / the field by the side of the gap layer of said magnetic pole partial layer, and a crosswise both-sides side ] said yoke partial layer magnetically to said magnetic pole partial layer.
[Claim 2] It is the thin film magnetic head according to claim 1 characterized by arranging said 1st magnetic layer at the backside [ the travelling direction of a record medium ], and arranging said 2nd magnetic layer at a before [ the travelling direction of a record medium ] side.
[Claim 3] Said yoke partial layer is the thin film magnetic head according to claim 1 or 2 characterized by including the 2nd layer which touched the field by the side of the gap layer of said 1st magnetic layer and said magnetic pole partial layer, touched the 1st layer magnetically connected to these, and said both-sides side of the cross direction of the 1st layer and said magnetic pole partial layer, and was magnetically connected to these.
[Claim 4] For the gap layer of said magnetic pole partial layer, said 2nd layer of said yoke partial layers is the thin film magnetic head according to claim 3 characterized by connecting with the field of an opposite hand magnetically further.
[Claim 5] For the medium opposed face of said magnetic pole partial layer, said yoke partial layer is the thin film magnetic head according to claim 1 or 2 characterized by connecting magnetically to said magnetic pole partial layer in the end face of an opposite hand further.
[Claim 6] The 1st layer which said yoke partial layer touched the field by the side of the gap layer of said 1st magnetic layer and said magnetic pole partial layer, and was magnetically connected to these, The medium opposed face of said 1st layer and said magnetic pole partial layer is the thin film magnetic head according to claim 5 characterized by including the 2nd layer which touched the end face of an opposite hand, and the crosswise both-sides side, and was magnetically connected to these.
[Claim 7] For the gap layer of said magnetic pole partial layer, said 2nd layer of said yoke partial layers is the thin film magnetic head according to claim 6 characterized by connecting with the field of an opposite hand magnetically further.
[Claim 8] The edge by the side of the medium opposed face of said yoke partial layer is the thin film magnetic head according to claim 1 to 7 characterized by being arranged in the location distant from the medium opposed face.
[Claim 9] The width of face of the part which touches said yoke partial layer of said magnetic pole partial layer is the thin film magnetic head according to claim 1 to 8 characterized by being larger than the width of

face in the medium opposed face of said magnetic pole partial layer.
[Claim 10] It is the thin film magnetic head according to claim 1 to 9 to which the medium opposed face of said magnetic pole partial layer is characterized by the die length to the end face of an opposite hand being 2 micrometers or more from a medium opposed face.
[Claim 11] Furthermore, the thin film magnetic head according to claim 1 to 10 characterized by having the non-magnetic layer which touches the field of an opposite hand with the gap layer of said magnetic pole partial layer.
[Claim 12] Said non-magnetic layer is the thin film magnetic head according to claim 11 characterized by having exposed to a medium opposed face.
[Claim 13] For the gap layer of said magnetic pole partial layer, said a part of yoke partial layer is the thin film magnetic head according to claim 11 or 12 characterized by adjoining the field of an opposite hand and connecting with said magnetic pole partial layer magnetically through said non-magnetic layer through said non-magnetic layer.
[Claim 14] Said non-magnetic layer is the thin film magnetic head according to claim 11 to 13 characterized by consisting of an ingredient with the etch rate smaller than the ingredient which constitutes said magnetic pole partial layer, and the ingredient which constitutes the part which touches a magnetic pole partial layer among said gap layers to dry etching.
[Claim 15] Said some of thin film coils [ at least ] are the thin film magnetic head according to claim 1 to 14 characterized by being arranged in the location near [ location / of said 1st magnetic layer and magnetic pole partial layer of the 2nd magnetic layer / middle ] the 1st magnetic layer.
[Claim 16] Said gap layer is the thin film magnetic head according to claim 1 to 15 characterized by having the 1st part which it consists of an ingredient which has a fluidity at the time of formation, is filled up among some [ at least ] coils of said thin film coil at least, and is not exposed to a medium opposed face, and the 2nd part which consists of an ingredient in which corrosion resistance, rigidity, and insulation excelled said 1st part, and is exposed to a medium opposed face.
[Claim 17] Said 1st part is the thin film magnetic head according to claim 16 characterized by consisting of a non-conductive non-magnetic material of an organic system, or spin-on glass film.
[Claim 18] Said 2nd part is the thin film magnetic head according to claim 16 or 17 characterized by consisting of a non-conductive non-magnetic material of an inorganic system.
[Claim 19] Furthermore, the thin film magnetic head according to claim 1 to 18 characterized by having a magneto-resistive effect component as a playback component.
[Claim 20] Furthermore, the thin film magnetic head according to claim 19 characterized by having the 1st for shielding said magneto-resistive effect component and the 2nd shielding layer which have been arranged so that the part by the side of said medium opposed face may counter on both sides of said magneto-resistive effect component.
[Claim 21] Said 1st magnetic layer is the thin film magnetic head according to claim 20 characterized by serving as said 2nd shielding layer.
[Claim 22] The thin film magnetic head according to claim 1 to 21 characterized by being used for vertical magnetic recording.
[Claim 23] While the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium is included The 1st and 2nd magnetic layers each other magnetically connected in the location distant from said medium opposed face, At least the gap layer which consisted of a non-magnetic material and was prepared between said 1st magnetic layer and 2nd magnetic layer, and a part between said 1st and 2nd magnetic layers It has the thin film coil prepared in the condition of having insulated to said 1st and 2nd magnetic layers. Said 2nd magnetic layer The magnetic pole partial layer as which the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects magnetically said magnetic pole part and said 1st magnetic layer. The saturation magnetic flux density of said magnetic pole partial layer The process which is the manufacture approach of the thin film magnetic head which is more than the saturation magnetic flux density of said yoke partial layer, and forms said 1st magnetic layer, The field by the side of the a part of [ at least ] 2nd [ of said thin film coil ] magnetic layer is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of said gap layer in a medium opposed face ] magnetic layer. And said yoke partial layer sets at least to the field by the side of the gap layer of said magnetic pole partial layer, and a crosswise both-sides side. The manufacture approach of the thin film magnetic head characterized by having the process which forms said gap layer, a thin film coil,

and the 2nd magnetic layer on said 1st magnetic layer so that it may connect magnetically to said magnetic pole partial layer.
[Claim 24] For the medium opposed face of said magnetic pole partial layer, said yoke partial layer is the manufacture approach of the thin film magnetic head according to claim 23 characterized by connecting magnetically to said magnetic pole partial layer in the end face of an opposite hand further.
[Claim 25] The 1st layer which said yoke partial layer touched the field by the side of the gap layer of said 1st magnetic layer and said magnetic pole partial layer, and was magnetically connected to these, The process which forms said gap layer, a thin film coil, and the 2nd magnetic layer including the 2nd layer which touched the both-sides side of the cross direction of said 1st layer and said magnetic pole partial layer, and was magnetically connected to these The process which forms said a part of gap layer which insulates this thin film coil with said thin film coil to a perimeter on said 1st magnetic layer, The process which forms the 1st layer of said yoke partial layers on [ some ] said 1st magnetic layer and said gap layer, Until said 1st layer is exposed with the process which forms said a part of other gap layers a part of said 1st magnetic layer, said gap layer, and on said 1st layer The process which grinds said a part of other gap layers, and carries out flattening of some [ other ] top faces of said 1st layer and said gap layer, The process which forms the etched layer which consists of an ingredient which constitutes said magnetic pole partial layer on [ some / other ] said 1st layer by which flattening was carried out, and said gap layer, Said etched layer is selectively etched by dry etching. The manufacture approach of the thin film magnetic head according to claim 23 characterized by including the process at which said 1st layer is exposed while determining the appearance of said magnetic pole partial layer which touches said 1st layer, and the process which forms the 2nd layer of said yoke partial layers on said 1st layer.
[Claim 26] For the medium opposed face of said magnetic pole partial layer, the 2nd layer of said yoke partial layers is the manufacture approach of the thin film magnetic head according to claim 25 characterized by touching the end face of an opposite hand and connecting magnetically to this further.
[Claim 27] The process which forms said gap layer, a thin film coil, and the 2nd magnetic layer is the manufacture approach of the thin film magnetic head according to claim 25 or 26 further characterized by including the process which carries out flattening of the top face of said etched layer by polish after the process which forms said etched layer.
[Claim 28] The process which forms said gap layer, a thin film coil, and the 2nd magnetic layer Furthermore, the process which forms a non-magnetic layer on said etched layer after the process which forms said etched layer, The process which etches said etched layer including the process which forms the mask corresponding to the configuration of a magnetic pole partial layer on said non-magnetic layer The manufacture approach of the thin film magnetic head according to claim 25 to 27 characterized by etching said non-magnetic layer and said etched layer using said mask.
[Claim 29] The process which forms said mask is the manufacture approach of the thin film magnetic head according to claim 28 characterized by forming the resist frame which has the opening section corresponding to the configuration of a magnetic pole partial layer on said non-magnetic layer, and forming said mask in the opening circles of this resist frame.
[Claim 30] The 2nd layer of said yoke partial layers is the manufacture approach of the thin film magnetic head according to claim 25 to 29 characterized by being formed by electroplating.
[Claim 31] The process which forms the 2nd layer of said yoke partial layers The process which forms wrap resist covering for the part by the side of the medium opposed face in said magnetic pole partial layer, The process which forms the electrode layer for electroplating on the 1st layer of said resist covering, said magnetic pole partial layer, and said yoke partial layers, The manufacture approach of the thin film magnetic head according to claim 30 characterized by including the process which forms a layer [ 2nd ] yoke partial layer with electroplating using said electrode layer.
[Claim 32] While the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium is included The 1st and 2nd magnetic layers each other magnetically connected in the location distant from said medium opposed face, At least the gap layer which consisted of a non-magnetic material and was prepared between said 1st magnetic layer and 2nd magnetic layer, and a part between said 1st and 2nd magnetic layers It is the thin film magnetic head equipped with the thin film coil prepared in the condition of having insulated to said 1st and 2nd magnetic layers. The field by the side of the a part of [ at least ] 2nd [ of said thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of said gap layer in a medium opposed face ] magnetic layer. Said 2nd magnetic layer The magnetic pole partial layer as which

the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects magnetically said magnetic pole part and said 1st magnetic layer. The saturation magnetic flux density of said magnetic pole partial layer It is more than the saturation magnetic flux density of said yoke partial layer. Said yoke partial layer In the field by the side of the gap layer of said magnetic pole partial layer, it connects magnetically to said magnetic pole partial layer at least. The amount of [ of said yoke partial layer and a magnetic pole partial layer ] connection The thin film magnetic head characterized by being arranged in the location by the side of a medium opposed face rather than a part for the connection of said 1st magnetic layer and a yoke partial layer.

[Claim 33] For the 1st magnetic layer of said yoke partial layer, the part which does not touch said magnetic pole partial layer among the fields of an opposite hand is the thin film magnetic head according to claim 32 characterized by being arranged at the 1st magnetic layer side rather than the field by the side of the gap layer of said magnetic pole partial layer.

[Claim 34] For the 1st magnetic layer of said yoke partial layer, a part of field [ at least ] of an opposite hand is the thin film magnetic head according to claim 32 or 33 characterized by approaching the 1st magnetic layer gradually as it separates from said magnetic pole partial layer.

[Claim 35] It is the thin film magnetic head according to claim 32 to 34 characterized by arranging said 1st magnetic layer at the backside [ the travelling direction of a record medium ], and arranging said 2nd magnetic layer at a before [ the travelling direction of a record medium ] side.

[Claim 36] The edge by the side of the medium opposed face of said yoke partial layer is the thin film magnetic head according to claim 32 to 35 characterized by being arranged in the location distant from the medium opposed face.

[Claim 37] The width of face of the part which touches said yoke partial layer of said magnetic pole partial layer is the thin film magnetic head according to claim 32 to 36 characterized by being larger than the width of face in the medium opposed face of said magnetic pole partial layer.

[Claim 38] It is the thin film magnetic head according to claim 32 to 37 to which the medium opposed face of said magnetic pole partial layer is characterized by the die length to the end face of an opposite hand being 2 micrometers or more from a medium opposed face.

[Claim 39] Furthermore, the thin film magnetic head according to claim 32 to 38 characterized by having the non-magnetic layer which touches the field of an opposite hand with the gap layer of said magnetic pole partial layer.

[Claim 40] Said non-magnetic layer is the thin film magnetic head according to claim 39 characterized by having exposed to a medium opposed face.

[Claim 41] Said non-magnetic layer is the thin film magnetic head according to claim 39 or 40 characterized by consisting of an ingredient with the etch rate smaller than the ingredient which constitutes said magnetic pole partial layer, and the ingredient which constitutes the part which touches a magnetic pole partial layer among said gap layers to dry etching.

[Claim 42] Said some of thin film coils [ at least ] are the thin film magnetic head according to claim 32 to 41 characterized by being arranged in the location near [ location / of said 1st magnetic layer and magnetic pole partial layer of the 2nd magnetic layer / middle ] the 1st magnetic layer.

[Claim 43] Said gap layer is the thin film magnetic head according to claim 32 to 42 characterized by having the 1st part which it consists of an ingredient which has a fluidity at the time of formation, is filled up among some [ at least ] coils of said thin film coil at least, and is not exposed to a medium opposed face, and the 2nd part which consists of an ingredient in which corrosion resistance, rigidity, and insulation excelled said 1st part, and is exposed to a medium opposed face.

[Claim 44] Said 1st part is the thin film magnetic head according to claim 43 characterized by consisting of a non-conductive non-magnetic material of an organic system, or spin-on glass film.

[Claim 45] Said 2nd part is the thin film magnetic head according to claim 43 or 44 characterized by consisting of a non-conductive non-magnetic material of an inorganic system.

[Claim 46] Furthermore, the thin film magnetic head according to claim 32 to 45 characterized by having a magneto-resistive effect component as a playback component.

[Claim 47] Furthermore, the thin film magnetic head according to claim 46 characterized by having the 1st for shielding said magneto-resistive effect component and the 2nd shielding layer which have been arranged so that the part by the side of said medium opposed face may counter on both sides of said magneto-resistive effect component.

[Claim 48] Said 1st magnetic layer is the thin film magnetic head according to claim 47 characterized by serving as said 2nd shielding layer.

[Claim 49] The thin film magnetic head according to claim 32 to 48 characterized by being used for vertical magnetic recording.
[Claim 50] While the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium is included The 1st and 2nd magnetic layers each other magnetically connected in the location distant from said medium opposed face, At least the gap layer which consisted of a non-magnetic material and was prepared between said 1st magnetic layer and 2nd magnetic layer, and a part between said 1st and 2nd magnetic layers It has the thin film coil prepared in the condition of having insulated to said 1st and 2nd magnetic layers. Said 2nd magnetic layer The magnetic pole partial layer as which the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects magnetically said magnetic pole part and said 1st magnetic layer. The saturation magnetic flux density of said magnetic pole partial layer The process which is the manufacture approach of the thin film magnetic head which is more than the saturation magnetic flux density of said yoke partial layer, and forms said 1st magnetic layer, The field by the side of the a part of [ at least ] 2nd [ of said thin film coil ] magnetic layer is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of said gap layer in a medium opposed face ] magnetic layer. And said yoke partial layer is magnetically connected to said magnetic pole partial layer in the field by the side of the gap layer of said magnetic pole partial layer at least. The amount of [ of said yoke partial layer and a magnetic pole partial layer ] connection so that it may be arranged in the location by the side of a medium opposed face rather than a part for the connection of said 1st magnetic layer and a yoke partial layer The manufacture approach of the thin film magnetic head characterized by having the process which forms said gap layer, a thin film coil, and the 2nd magnetic layer on said 1st magnetic layer.
[Claim 51] The process which forms said gap layer, a thin film coil, and the 2nd magnetic layer The process which forms said a part of gap layer which insulates this thin film coil with said thin film coil to a perimeter on said 1st magnetic layer, The process which forms said yoke partial layer on [ some ] said 1st magnetic layer and said gap layer, Until the process which forms said a part of other gap layers on a part of said 1st magnetic layer, said gap layer, and said yoke partial layer, and said yoke partial layer are exposed The process which grinds said a part of other gap layers, and carries out flattening of some [ other ] top faces of said yoke partial layer and said gap layer, The process which forms the etched layer which consists of an ingredient which constitutes said magnetic pole partial layer on [ some / other ] said yoke partial layer by which flattening was carried out, and said gap layer, Said etched layer is selectively etched by dry etching. The manufacture approach of the thin film magnetic head according to claim 50 which is made to expose said yoke partial layer while determining the appearance of said magnetic pole partial layer which touches said yoke partial layer, and is characterized by including the process which forms the field of an opposite hand with the gap layer of a yoke partial layer.
[Claim 52] The process which forms said gap layer, a thin film coil, and the 2nd magnetic layer is the manufacture approach of the thin film magnetic head according to claim 51 further characterized by including the process which carries out flattening of the top face of said etched layer by polish after the process which forms said etched layer.
[Claim 53] The process which forms said gap layer, a thin film coil, and the 2nd magnetic layer Furthermore, the process which forms a non-magnetic layer on said etched layer after the process which forms said etched layer, The process which etches said etched layer including the process which forms the mask corresponding to the configuration of a magnetic pole partial layer on said non-magnetic layer The manufacture approach of the thin film magnetic head according to claim 51 or 52 characterized by etching said non-magnetic layer and said etched layer using said mask.
[Claim 54] The process which forms said mask is the manufacture approach of the thin film magnetic head according to claim 53 characterized by forming the resist frame which has the opening section corresponding to the configuration of a magnetic pole partial layer on said non-magnetic layer, and forming said mask in the opening circles of this resist frame.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the thin film magnetic head used for magnetic recorder and reproducing devices, such as a magnetic disk drive and a magnetic tape unit, and its manufacture approach.
[0002]
[Description of the Prior Art] There are a longitudinal magnetic-recording method which makes the sense of signal magnetization the field inboard (longitudinal direction) of a record medium, and vertical magnetic recording which makes the sense of signal magnetization a vertical direction to the field of a record medium in the recording method in a magnetic recorder and reproducing device. It is said that it is hard to be influenced of heat fluctuation by the record medium, and vertical magnetic recording can realize high track recording density compared with a longitudinal magnetic-recording method.
[0003] The medium opposed face to which the thin film magnetic head for longitudinal magnetic-recording methods generally counters a record medium (air bearing side), At least the 1st and 2nd magnetic layers containing the magnetic pole part which each other is connected magnetically and counters a medium opposed face side mutually through the gap section, and a part between the 1st and 2nd magnetic layers It has structure equipped with the thin film coil prepared in the condition of having insulated to the 1st and 2nd magnetic layers.
[0004] On the other hand, there are the thin film magnetic head for longitudinal magnetic-recording methods, a ring head of the same structure, and a single magnetic pole head that impresses a vertical field to a record medium by the one main pole in the thin film magnetic head for vertical magnetic recording. When using a single magnetic pole head, generally as a record medium, the two-layer medium which carried out the laminating of a soft magnetism layer and the magnetic-recording layer is used on a substrate.
[0005] By the way, in the thin film magnetic head, in order to raise track density, a cutback of the width of recording track is desired. And in order to reduce the width of recording track, without reducing the reinforcement of the field impressed to a record medium, the magnetic layer containing a magnetic pole part is divided into a magnetic pole part and the yoke part with which it connected magnetically to this magnetic pole part, and various thin film magnetic heads which made saturation magnetic flux density of a magnetic pole part larger than the saturation magnetic flux density of a yoke part are also proposed.
[0006] As mentioned above, the example of the thin film magnetic head of the structure which divided the magnetic layer containing a magnetic pole part into the magnetic pole part and the yoke part is shown in JP,2000-57522,A, JP,2000-67413,A, JP,11-102506,A, etc.
[0007] In the thin film magnetic head shown in each above-mentioned official report, the 2nd magnetic layer arranged among the 1st magnetic layer and the 2nd magnetic layer at the before [ the travelling direction of a record medium ] side (air runoff one end in the slider containing the thin film magnetic head) is divided into the magnetic pole part and the yoke part by each.
[0008] Moreover, in the thin film magnetic head shown in each above-mentioned official report, the yoke part is arranged by each so that a coil may be bypassed from a part for a magnetic connection to the magnetic pole part of the 1st magnetic layer and the 2nd magnetic layer.
[0009] In the thin film magnetic head shown in JP,2000-57522,A, the 2nd magnetic layer has the main magnetic film and the auxiliary magnetic film. A magnetic pole part is constituted by the part by the side of the medium opposed face of the main magnetic film, and the yoke part is constituted from this head by other parts and auxiliary magnetic films of the main magnetic film.
[0010] In the thin film magnetic head shown in JP,2000-67413,A, the 2nd magnetic layer has the magnetic pole partial layer containing a magnetic pole part, and the yoke partial layer containing a yoke part. The

magnetic pole partial layer is connected to the yoke partial layer and the magnetic target on the back end side (a medium opposed face is a field of an opposite hand), the side face (a medium opposed face and field vertical to the field of the gap section), and the top face (the gap section is the field of an opposite hand).
[0011] In the thin film magnetic head shown in JP,11-102506,A, the 2nd magnetic layer has the magnetic pole partial layer containing a magnetic pole part, and the yoke partial layer containing a yoke part. The magnetic pole partial layer is connected to the yoke partial layer and the magnetic target on the side face and top face.
[0012] On the other hand, about the thin film magnetic head for vertical magnetic recording, an example of the structure of a single magnetic pole head is shown in drawing 2 in "the Nikkei electronics September 25, 2000 issue (no.779) and p.206." With this head, the magnetic layer containing the main pole is a monolayer.
[0013]
[Problem(s) to be Solved by the Invention] 60 gigabits / (inch) 2 -- when it is going to realize the magnetic recorder and reproducing device which has the above big surface recording densities, promising ** of adopting vertical magnetic recording is carried out. [ for example, ] however, the thin film magnetic head suitable for vertical magnetic recording -- it is -- 60 gigabits / (inch) 2 -- the head which has the engine performance for realizing the magnetic recorder and reproducing device which has the above big surface recording densities is not realizable. It is because it has the trouble that the conventional thin film magnetic head explains below.
[0014] First, each thin film magnetic head shown in each aforementioned official report is a head for longitudinal magnetic-recording methods on structure, and is not suitable for vertical magnetic recording. There is a trouble that the field of a direction vertical to the field of a record medium generated from a magnetic pole part is small since it is the structure arranged so that throat height is short while the thickness of the gap section is all small, and a yoke part may bypass a coil in the thin film magnetic head shown in each official report when explained concretely. Moreover, by the thin film magnetic head shown in each aforementioned official report, the edge of an opposite hand all tends to curve with the gap section of a magnetic pole part under the effect of the process after etching for carrying out patterning of the magnetic pole part of the 2nd magnetic layer, or formation of a magnetic pole part. Therefore, in the thin film magnetic head shown in each aforementioned official report, there is a trouble that it is difficult for distortion to arise in the bit pattern configuration in a record medium, therefore to raise track recording density. Moreover, in the thin film magnetic head shown in each aforementioned official report, all, since a yoke part is structure arranged so that a coil may be bypassed, magnetic-path length becomes long, therefore it has the trouble that a RF property gets worse.
[0015] Moreover, in the thin film magnetic head shown in JP,11-102506,A, the magnetic pole partial layer is connected to the yoke partial layer and the magnetic target only on the side face and top face. Therefore, with this head, the area for a magnetic connection of a magnetic pole partial layer and a yoke partial layer is small, therefore magnetic flux is saturated in a part for this connection, and there is a trouble that the field generated from a magnetic pole part in a medium opposed face becomes small.
[0016] On the other hand, in the thin film magnetic head shown in drawing 2 in "the Nikkei electronics September 25, 2000 issue (no.779) and p.206", the magnetic layer containing the main pole is a monolayer. With this head, in order to make small thickness of the magnetic layer in a medium opposed face, the whole magnetic layer is thin. Therefore, magnetic flux tends to be saturated with this head in the middle of a magnetic layer, and there is a trouble that the field generated from the main pole in a medium opposed face becomes small, with it. Moreover, with this head, when the need of carrying out flattening of the main pole is considered, flattening of the whole magnetic layer must be carried out, therefore in this head, a magnetic path is square and long. Such structure is inefficient-like from a viewpoint of magnetic field strength and a RF property.
[0017] It is in offering the thin film magnetic head the object can enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part by having made this invention in view of this trouble, and shortens magnetic-path length, and it enabled it to raise a RF property, and its manufacture approach.
[0018]
[Means for Solving the Problem] While the 1st thin film magnetic head of this invention contains the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium The 1st and 2nd magnetic layers each other magnetically connected in the location distant from the medium opposed face, At least the gap layer which consisted of a non-magnetic material and was

prepared between the 1st magnetic layer and the 2nd magnetic layer, and a part between the 1st and 2nd magnetic layers It has the thin film coil prepared in the condition of having insulated to the 1st and 2nd magnetic layers. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. The 2nd magnetic layer The magnetic pole partial layer as which the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects magnetically a magnetic pole partial layer and the 1st magnetic layer. The saturation magnetic flux density of a magnetic pole partial layer It is more than the saturation magnetic flux density of a yoke partial layer, and the yoke partial layer is magnetically connected to the magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and the crosswise both-sides side at least.

[0019] In the 1st thin film magnetic head of this invention, the 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer, and the yoke partial layer is magnetically connected to the magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and the crosswise both-sides side at least. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since the yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to the magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and the crosswise both-sides side at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. these things to this invention -- electromagnetism -- it becomes possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property.

[0020] In the 1st thin film magnetic head of this invention, the 1st magnetic layer may be arranged at the backside [ the travelling direction of a record medium ], and the 2nd magnetic layer may be arranged at a before [ the travelling direction of a record medium ] side.

[0021] Moreover, in the 1st thin film magnetic head of this invention, a yoke partial layer may touch the field by the side of the gap layer of the 1st magnetic layer and a magnetic pole partial layer, may touch the both-sides side of the cross direction of the 1st layer magnetically connected to these, the 1st layer, and a magnetic pole partial layer, and may contain the 2nd layer magnetically connected to these. In this case, the layer [ 2nd ] yoke partial layer may be further connected with the gap layer of a magnetic pole partial layer magnetically in the field of an opposite hand.

[0022] Moreover, in the 1st thin film magnetic head of this invention, the yoke partial layer may be further connected with the medium opposed face of a magnetic pole partial layer magnetically to the magnetic pole partial layer in the end face of an opposite hand. In this case, a yoke partial layer touches the field by the side of the gap layer of the 1st magnetic layer and a magnetic pole partial layer, and the medium opposed face of the 1st layer magnetically connected to these, the 1st layer, and a magnetic pole partial layer may touch the end face of an opposite hand, and a crosswise both-sides side, and may contain the 2nd layer magnetically connected to these. In this case, the layer [ 2nd ] yoke partial layer may be further connected with the gap layer of a magnetic pole partial layer magnetically in the field of an opposite hand.

[0023] Moreover, in the 1st thin film magnetic head of this invention, the edge by the side of the medium opposed face of a yoke partial layer may be arranged in the location distant from the medium opposed face.

[0024] Moreover, in the 1st thin film magnetic head of this invention, the width of face of the part which touches the yoke partial layer of a magnetic pole partial layer may be larger than the width of face in the medium opposed face of a magnetic pole partial layer.

[0025] Moreover, in the 1st thin film magnetic head of this invention, the die length to the end face of an opposite hand of the medium opposed face of a magnetic pole partial layer may be 2 micrometers or more from a medium opposed face.

[0026] Moreover, in the 1st thin film magnetic head of this invention, you may have further the non-magnetic layer which touches the gap layer of a magnetic pole partial layer in the field of an opposite hand. In this case, the non-magnetic layer may be exposed to a medium opposed face. Moreover, through the non-magnetic layer, with the gap layer of a magnetic pole partial layer, a part of yoke partial layer adjoins the

field of an opposite hand, and it may be magnetically connected to the magnetic pole partial layer through the non-magnetic layer. Moreover, the non-magnetic layer may consist of an ingredient with the etch rate smaller than the ingredient which constitutes a magnetic pole partial layer, and the ingredient which constitutes the part which touches a magnetic pole partial layer among gap layers to dry etching.
[0027] Moreover, in the 1st thin film magnetic head of this invention, some thin film coils [ at least ] may be arranged in the location near [ location / of the 1st magnetic layer and the magnetic pole partial layer of the 2nd magnetic layer / middle ] the 1st magnetic layer.
[0028] Moreover, in the 1st thin film magnetic head of this invention, a gap layer consists of an ingredient which has a fluidity at the time of formation, it fills up among some [ at least ] coils of a thin film coil at least, and you may have the 1st part which is not exposed to a medium opposed face, and the 2nd part which consists of an ingredient in which corrosion resistance, rigidity, and insulation excelled the 1st part, and is exposed to a medium opposed face. In this case, the 1st part may consist of a non-conductive non-magnetic material of an organic system, or spin-on glass film. Moreover, the 2nd part may consist of a non-conductive non-magnetic material of an inorganic system.
[0029] Moreover, in the 1st thin film magnetic head of this invention, you may have the magneto-resistive effect component as a playback component further. In this case, you may have the 1st for shielding a magneto-resistive effect component and the 2nd shielding layer which have been further arranged so that the part by the side of a medium opposed face may counter on both sides of a magneto-resistive effect component. Moreover, the 1st magnetic layer may serve as the 2nd shielding layer.
[0030] Moreover, the 1st thin film magnetic head of this invention may be used for vertical magnetic recording.
[0031] The manufacture approach of the 1st thin film magnetic head of this invention While the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium is included The 1st and 2nd magnetic layers each other magnetically connected in the location distant from the medium opposed face, At least the gap layer which consisted of a non-magnetic material and was prepared between the 1st magnetic layer and the 2nd magnetic layer, and a part between the 1st and 2nd magnetic layers It has the thin film coil prepared in the condition of having insulated to the 1st and 2nd magnetic layers. The 2nd magnetic layer The magnetic pole partial layer as which the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects magnetically a magnetic pole partial layer and the 1st magnetic layer. The saturation magnetic flux density of a magnetic pole partial layer The process which is the approach of manufacturing the thin film magnetic head which is more than the saturation magnetic flux density of a yoke partial layer, and forms the 1st magnetic layer, The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. And at least, a yoke partial layer is equipped with the process which forms a gap layer, a thin film coil, and the 2nd magnetic layer on the 1st magnetic layer so that it may connect magnetically to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and a crosswise both-sides side.
[0032] By the manufacture approach of the 1st thin film magnetic head of this invention The 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer, and a yoke partial layer is magnetically connected to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and a crosswise both-sides side at least. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since a yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and a crosswise both-sides side at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. these things to this invention -- electromagnetism -- it becomes possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property.

[0033] In the manufacture approach of the 1st thin film magnetic head of this invention, a yoke partial layer may be further connected with the medium opposed face of a magnetic pole partial layer magnetically to a magnetic pole partial layer in the end face of an opposite hand.
[0034] In the manufacture approach of the 1st thin film magnetic head of this invention moreover, a yoke partial layer The 1st layer which touched the field by the side of the gap layer of the 1st magnetic layer and a magnetic pole partial layer, and was magnetically connected to these, The process which forms a gap layer, a thin film coil, and the 2nd magnetic layer including the 2nd layer which touched the both-sides side of the cross direction of the 1st layer and a magnetic pole partial layer, and was magnetically connected to these The process which forms a part of gap layer which insulates this thin film coil with a thin film coil to a perimeter on the 1st magnetic layer, Until the 1st layer is exposed with the process which forms a layer [ 1st ] yoke partial layer on [ some ] the 1st magnetic layer and a gap layer, and the process which forms a part of other gap layers a part of 1st magnetic layer, gap layer, and on the 1st layer The process which grinds a part of other gap layers, and carries out flattening of some [ other ] top faces of the 1st layer and a gap layer, The process which forms the etched layer which consists of an ingredient which constitutes a magnetic pole partial layer on [ some / other ] the 1st layer by which flattening was carried out, and a gap layer, An etched layer may be selectively etched by dry etching, and the process at which the 1st layer is exposed while determining the appearance of the magnetic pole partial layer which touches the 1st layer, and the process which forms a layer [ 2nd ] yoke partial layer on the 1st layer may be included.
[0035] In this case, further, a layer [ 2nd ] yoke partial layer touches the end face of an opposite hand, and it may be magnetically connected with the medium opposed face of a magnetic pole partial layer to this. Moreover, the process which forms a gap layer, a thin film coil, and the 2nd magnetic layer may include further the process which carries out flattening of the top face of an etched layer by polish after the process which forms an etched layer.
[0036] Moreover, the process as for which the process which forms a gap layer, a thin film coil, and the 2nd magnetic layer etches an etched layer after the process which forms an etched layer further including the process which forms a non-magnetic layer on an etched layer, and the process which forms the mask corresponding to the configuration of a magnetic pole partial layer on a non-magnetic layer may etch a non-magnetic layer and an etched layer using a mask. The process which forms a mask may form the resist frame which has the opening section corresponding to the configuration of a magnetic pole partial layer on a non-magnetic layer, and may form a mask in the opening circles of this resist frame.
[0037] Moreover, a layer [ 2nd ] yoke partial layer may be formed by electroplating. In this case, the process which forms a layer [ 2nd ] yoke partial layer may include the process which forms wrap resist covering for the part by the side of the medium opposed face in a magnetic pole partial layer, the process which forms the electrode layer for electroplating on the 1st layer of resist covering, a magnetic pole partial layer, and a yoke partial layer, and the process which forms a layer [ 2nd ] yoke partial layer with electroplating using an electrode layer.
[0038] While the 2nd thin film magnetic head of this invention contains the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium The 1st and 2nd magnetic layers each other magnetically connected in the location distant from the medium opposed face, At least the gap layer which consisted of a non-magnetic material and was prepared between the 1st magnetic layer and the 2nd magnetic layer, and a part between the 1st and 2nd magnetic layers It is the thin film magnetic head equipped with the thin film coil prepared in the condition of having insulated to the 1st and 2nd magnetic layers. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. The 2nd magnetic layer The magnetic pole partial layer as which the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects a magnetic pole part and the 1st magnetic layer magnetically. The saturation magnetic flux density of a magnetic pole partial layer It is more than the saturation magnetic flux density of a yoke partial layer. A yoke partial layer In the field by the side of the gap layer of a magnetic pole partial layer, it connects magnetically to the magnetic pole partial layer at least, and a part for the connection of a yoke partial layer and a magnetic pole partial layer is arranged in the location by the side of a medium opposed face rather than a part for the connection of the 1st magnetic layer and a yoke partial layer.
[0039] In the 2nd thin film magnetic head of this invention, the 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film

coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. A yoke partial layer In the field by the side of the gap layer of a magnetic pole partial layer, it connects magnetically to the magnetic pole partial layer at least, and a part for the connection of a yoke partial layer and a magnetic pole partial layer is arranged in the location by the side of a medium opposed face rather than a part for the connection of the 1st magnetic layer and a yoke partial layer. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since the yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to the magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. these things to this invention -- electromagnetism -- it becomes possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property.

[0040] In the 2nd thin film magnetic head of this invention, the part which does not touch the 1st magnetic layer of a yoke partial layer with a magnetic pole partial layer among the fields of an opposite hand may be arranged at the 1st magnetic layer side rather than the field by the side of the gap layer of a magnetic pole partial layer.

[0041] Moreover, in the 2nd thin film magnetic head of this invention, with the 1st magnetic layer of a yoke partial layer, it may be approaching the 1st magnetic layer gradually as a part of field [ at least ] of an opposite hand separates from a magnetic pole partial layer.

[0042] Moreover, in the 2nd thin film magnetic head of this invention, the 1st magnetic layer may be arranged at the backside [ the travelling direction of a record medium ], and the 2nd magnetic layer may be arranged at a before [ the travelling direction of a record medium ] side.

[0043] Moreover, in the 2nd thin film magnetic head of this invention, the edge by the side of the medium opposed face of a yoke partial layer may be arranged in the location distant from the medium opposed face.

[0044] Moreover, in the 2nd thin film magnetic head of this invention, the width of face of the part which touches the yoke partial layer of a magnetic pole partial layer may be larger than the width of face in the medium opposed face of a magnetic pole partial layer.

[0045] Moreover, in the 2nd thin film magnetic head of this invention, the die length to the end face of an opposite hand of the medium opposed face of a magnetic pole partial layer may be 2 micrometers or more from a medium opposed face.

[0046] Moreover, in the 2nd thin film magnetic head of this invention, you may have further the non-magnetic layer which touches the gap layer of a magnetic pole partial layer in the field of an opposite hand. In this case, the non-magnetic layer may be exposed to a medium opposed face. Moreover, the non-magnetic layer may consist of an ingredient with the etch rate smaller than the ingredient which constitutes a magnetic pole partial layer, and the ingredient which constitutes the part which touches a magnetic pole partial layer among gap layers to dry etching.

[0047] Moreover, in the 2nd thin film magnetic head of this invention, some thin film coils [ at least ] may be arranged in the location near [ location / of the 1st magnetic layer and the magnetic pole partial layer of the 2nd magnetic layer / middle ] the 1st magnetic layer.

[0048] Moreover, in the 2nd thin film magnetic head of this invention, a gap layer consists of an ingredient which has a fluidity at the time of formation, it fills up among some [ at least ] coils of a thin film coil at least, and you may have the 1st part which is not exposed to a medium opposed face, and the 2nd part which consists of an ingredient in which corrosion resistance, rigidity, and insulation excelled the 1st part, and is exposed to a medium opposed face. In this case, the 1st part may consist of a non-conductive non-magnetic material of an organic system, or spin-on glass film. Moreover, the 2nd part may consist of a non-conductive non-magnetic material of an inorganic system.

[0049] Moreover, in the 2nd thin film magnetic head of this invention, you may have the magneto-resistive effect component as a playback component further. In this case, you may have the 1st for shielding a magneto-resistive effect component and the 2nd shielding layer which have been further arranged so that the part by the side of a medium opposed face may counter on both sides of a magneto-resistive effect component. Moreover, the 1st magnetic layer may serve as the 2nd shielding layer.

[0050] Moreover, the 2nd thin film magnetic head of this invention may be used for vertical magnetic

recording.
[0051] The manufacture approach of the 2nd thin film magnetic head of this invention While the magnetic pole part arranged so that predetermined spacing may be opened and it may counter mutually before and behind the medium opposed face which counters a record medium, and the travelling direction of a record medium is included The 1st and 2nd magnetic layers each other magnetically connected in the location distant from the medium opposed face, At least the gap layer which consisted of a non-magnetic material and was prepared between the 1st magnetic layer and the 2nd magnetic layer, and a part between the 1st and 2nd magnetic layers It has the thin film coil prepared in the condition of having insulated to the 1st and 2nd magnetic layers. The 2nd magnetic layer The magnetic pole partial layer as which the width of face in a medium opposed face specifies the width of recording track including a magnetic pole part, It has the yoke partial layer which connects magnetically a magnetic pole partial layer and the 1st magnetic layer. The saturation magnetic flux density of a magnetic pole partial layer The process which is the approach of manufacturing the thin film magnetic head which is more than the saturation magnetic flux density of a yoke partial layer, and forms the 1st magnetic layer, The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. And a yoke partial layer is magnetically connected to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer at least. The amount of [ of a yoke partial layer and a magnetic pole partial layer ] connection has the process which forms a gap layer, a thin film coil, and the 2nd magnetic layer on the 1st magnetic layer so that it may be arranged in the location by the side of a medium opposed face rather than a part for the connection of the 1st magnetic layer and a yoke partial layer.
[0052] By the manufacture approach of the 2nd thin film magnetic head of this invention The 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. A yoke partial layer In the field by the side of the gap layer of a magnetic pole partial layer, it connects magnetically to a magnetic pole partial layer at least, and a part for the connection of a yoke partial layer and a magnetic pole partial layer is arranged in the location by the side of a medium opposed face rather than a part for the connection of the 1st magnetic layer and a yoke partial layer. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since a yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. these things to this invention -- electromagnetism -- it becomes possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property.
[0053] In the manufacture approach of the 2nd thin film magnetic head of this invention, the process which forms a gap layer, a thin film coil, and the 2nd magnetic layer The process which forms a part of gap layer which insulates this thin film coil with a thin film coil to a perimeter on the 1st magnetic layer, Until the process which forms a yoke partial layer on [ some ] the 1st magnetic layer and a gap layer, the process which forms a part of other gap layers on a part of 1st magnetic layer, gap layer, and a yoke partial layer, and a yoke partial layer are exposed The process which grinds a part of other gap layers, and carries out flattening of some [ other ] top faces of a yoke partial layer and a gap layer, The process which forms the etched layer which consists of an ingredient which constitutes a magnetic pole partial layer on [ some / other ] the yoke partial layer by which flattening was carried out, and a gap layer, An etched layer may be selectively etched by dry etching, while determining the appearance of the magnetic pole partial layer which touches a yoke partial layer, a yoke partial layer may be exposed, and the process which forms the field of an opposite hand may be included with the gap layer of a yoke partial layer.
[0054] In this case, the process which forms a gap layer, a thin film coil, and the 2nd magnetic layer may include further the process which carries out flattening of the top face of an etched layer by polish after the process which forms an etched layer.
[0055] Moreover, the process as for which the process which forms a gap layer, a thin film coil, and the 2nd magnetic layer etches an etched layer after the process which forms an etched layer further including the

process which forms a non-magnetic layer on an etched layer, and the process which forms the mask corresponding to the configuration of a magnetic pole partial layer on a non-magnetic layer may etch a non-magnetic layer and an etched layer using a mask. The process which forms a mask may form the resist frame which has the opening section corresponding to the configuration of a magnetic pole partial layer on a non-magnetic layer, and may form a mask in the opening circles of this resist frame.
[0056]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.
[the gestalt of the 1st operation] -- with reference to drawing 1 thru/or drawing 5 , the thin film magnetic head concerning the gestalt of operation of the 1st of this invention is explained first. Drawing 1 is the sectional view showing the configuration of the thin film magnetic head concerning the gestalt of this operation. In addition, drawing 1 shows the medium opposed face and the cross section vertical to the field of a substrate. Moreover, the arrow head shown with Notation T in drawing 1 R> 1 expresses the travelling direction of a record medium. Drawing 2 is the perspective view showing the important section of the thin film magnetic head shown in drawing 1 . Drawing 3 is a perspective view in which it is expanded and shown near the magnetic pole part in drawing 2 . Drawing 4 is the front view showing a part of medium opposed face of the thin film magnetic head shown in drawing 1 . Drawing 5 is the front view expanding and showing the magnetic pole partial layer and non-magnetic layer in drawing 4 .
[0057] As shown in drawing 1 , the thin film magnetic head concerning the gestalt of this operation The substrate 1 which consists of ceramic ingredients, such as ARUTIKKU (aluminum 2O3, TiC), The insulating layer 2 which consists of insulating materials, such as an alumina (aluminum 2O3) formed on this substrate 1, The lower shielding layer 3 which consists of a magnetic material formed on this insulating layer 2, It has the MR (magneto-resistive effect) component 5 as a playback component formed through the insulating layer 4 on this lower shielding layer 3, and the up shielding layer 6 which consists of a magnetic material formed through the insulating layer 4 on this MR component 5. The thickness of the lower shielding layer 3 and the up shielding layer 6 is 1-2 micrometers, for example, respectively.
[0058] The end section of the MR component 5 is arranged at the medium opposed face (air bearing side) ABS. The component using the magnetosensitive film in which magneto-resistive effects, such as the AMR (anisotropy magneto-resistive effect) component, a GMR (giant magneto-resistance) component, or a TMR (tunnel magneto-resistive effect) component, are shown can be used for the MR component 5.
[0059] The non-magnetic layer 7 by which the thin film magnetic head was further formed on the up shielding layer 6, The 1st magnetic layer 8 which consists of a magnetic material formed on this non-magnetic layer 7, It filled up between the coils of the thin film coil 10 at least with insulating-layer 9A formed in the location which should form the thin film coil 10 on this 1st magnetic layer 8, and the thin film coil 10 formed on this insulating-layer 9A, and has insulating-layer 9B which is not exposed to the medium opposed face ABS. Contact hole 9a is formed in insulating-layer 9A in the location distant from the medium opposed face ABS. Moreover, with the gestalt of this operation, insulating-layer 9B is formed so that the whole thin film coil 10 may be covered.
[0060] The thickness of the 1st magnetic layer 8 is 1-2 micrometers. For example, an iron-nickel system alloy, i.e., a permalloy, is sufficient as the magnetic material which constitutes the 1st magnetic layer 8, and high saturation-magnetic-flux-density material which is mentioned later is sufficient as it.
[0061] Insulating-layer 9A consists of an ingredient non-conductive [, such as an alumina, ] and nonmagnetic, and the thickness is 0.1-1 micrometer.
[0062] The thin film coil 10 consists of conductive ingredients, such as copper, and the thickness of the coil is 0.3-2 micrometers. The number of turns of the thin film coil 10 are arbitrary, and its pitch of a coil is also arbitrary. Here, it considers as an example, and the pitch of 0.8 micrometers and a coil is set to 1.3 micrometers, and number of turns are set [ the thickness of the coil of the thin film coil 10 ] to 8 for the width of face of 1.3 micrometers and a coil. Moreover, the thin film coil 10 is wound around the surroundings of contact hole 9a.
[0063] Insulating-layer 9B consists of a non-conductive and nonmagnetic ingredient which has a fluidity at the time of formation. Insulating-layer 9B may be formed by the non-conductive non-magnetic material of an organic system like a photoresist (photopolymer), and, specifically, may be formed by the spin-on glass (SOG) film which consists of spreading glass.
[0064] It was further formed on insulating-layer 9A, having thin film applied it to the medium opposed face ABS from the part by the side of the medium opposed face ABS in insulating-layer 9B, and it is equipped with insulating-layer 9C exposed to the medium opposed face ABS. Insulating-layer 9C consists of a non-

conductive and nonmagnetic ingredient in which corrosion resistance, rigidity, and insulation excelled insulating-layer 9B. As such an ingredient, the non-conductive non-magnetic material of inorganic systems, such as an alumina and a silicon oxide (SiO2), can be used. The thickness of the sum total of insulating-layer 9A in the medium opposed face ABS and insulating-layer 9C is 3-6 micrometers.

[0065] Insulating layers 9A, 9B, and 9C constitute the gap layer 9 prepared between the 1st magnetic layer 8 and the 2nd magnetic layer 14 mentioned later. Insulating-layer 9B corresponds to the 1st part of the gap layer in this invention, and insulating layers 9A and 9C correspond to the 2nd part of the gap layer in this invention.

[0066] The field by the side of the 2nd magnetic layer 14 of the thin film coil 10 is arranged in the location by the side of the 1st magnetic layer 8 rather than the location of the edge by the side of the 2nd magnetic layer 14 of the gap layer 9 in the medium opposed face ABS (edge by the side of the magnetic layer 14 of insulating-layer 9C).

[0067] The thin film magnetic head is equipped with the 2nd magnetic layer 14 which consists of a magnetic material formed on the gap layer 9 further, and the protective layer 17 formed so that it might consist of an ingredient non-conductive [, such as an alumina, ] and nonmagnetic and the 2nd magnetic layer 14 might be covered.

[0068] The 2nd magnetic layer 14 has magnetic pole partial layer 14A containing a magnetic pole part, and yoke partial layer 14B used as a yoke part. yoke partial layer 14B touched the field by the side of the 1st magnetic layer 8 and the gap layer 9 of magnetic pole partial layer 14A, and was magnetically connected to these -- with 14B1 the 1st layer This 1st layer 14B1 and the medium opposed face ABS of magnetic pole partial layer 14A are an end face (it is hereafter called a back end side.) of an opposite hand. And a crosswise both-sides side is touched and 2nd layer 14 B-2s magnetically connected to these are included.

[0069] 14B1, the 1st layer is formed on the 1st magnetic layer 8 and insulating-layer 9B to the location of the end face of an opposite hand with the medium opposed face ABS of insulating-layer 9C towards the location of yoke partial layer 14B in which contact hole 9a was formed to the medium opposed face ABS. it can set in the location of contact hole 9a -- the 1st layer, the thickness of 14B1 is larger than the thickness of the sum total of insulating-layer 9A and insulating-layer 9B, for example, is 3 micrometers or more. The 1st layer, the edge by the side of the medium opposed face ABS of 14B1 is the location which separated 1.5 micrometers or more from the medium opposed face ABS, for example, and is arranged in the location near the medium opposed face ABS rather than the back end side of magnetic pole partial layer 14A. Here, the 1st layer of the edge by the side of the medium opposed face ABS of 14B1 and distance with the medium opposed face ABS are set to 5 micrometers as an example. For example, an iron-nickel system alloy, i.e., a permalloy, is sufficient as the magnetic material which constitutes 14B1 [ layer / 1st ], and high saturation-magnetic-flux-density material which is mentioned later is sufficient as it.

[0070] Flattening of the part by the side of the medium opposed face [ in / the 1st layer / 14B1 ] ABS of yoke partial layer 14B and the top face of insulating-layer 9C is carried out. magnetic pole partial layer 14A -- this -- flattening was carried out -- the 1st layer is formed on the top face of 14B1 and insulating-layer 9C. therefore, yoke partial layer 14B -- the 1st layer, 14B1 touches the field by the side of the gap layer 9 of magnetic pole partial layer 14A, and is magnetically connected to this.

[0071] The thin film magnetic head is further equipped with the non-magnetic layer 15 formed on magnetic pole partial layer 14A. The 1st layer of 2nd layer 14 B-2s of yoke partial layer 14B is arranged on 14B1 and a non-magnetic layer 15. The 1st layer of 2nd layer 14 B-2s touches the back end side of 14B1 and magnetic pole partial layer 14A, and a crosswise both-sides side, and they are magnetically connected to these. Moreover, the part by the side of the medium opposed face ABS of 2nd layer 14 B-2s adjoins the top face of magnetic pole partial layer 14A through a non-magnetic layer 15, and is magnetically connected to magnetic pole partial layer 14A through the non-magnetic layer 15. The thickness of 2nd layer 14 B-2s of yoke partial layer 14B is 0.5-2 micrometers. For example, an iron-nickel system alloy, i.e., a permalloy, is sufficient as the magnetic material which constitutes 2nd layer 14 B-2s, and high saturation-magnetic-flux-density material which is mentioned later is sufficient as it.

[0072] The thickness of magnetic pole partial layer 14A is 0.1-0.8 micrometers preferably, and is 0.3-0.8 micrometers still more preferably. Here, thickness of magnetic pole partial layer 14A is set to 0.5 micrometers as an example. Moreover, the die length from the medium opposed face ABS to the back end side of magnetic pole partial layer 14A is 2 micrometers or more. Here, this die length is set to 10 micrometers as an example.

[0073] As shown in drawing 3 , magnetic pole partial layer 14A contains the 1st part 14A1 arranged at the medium opposed face ABS side, and the 2nd part 14A2 arranged in the location which is distant from the

medium opposed face ABS from this 1st part 14A1. The 1st part 14A1 turns into a magnetic pole part in the 2nd magnetic layer 14. The magnetic pole part in the 1st magnetic layer 8 contains the part which counters the 1st part 14A1 of the above through the gap layer 9 among the 1st magnetic layer 8.

[0074] The 1st part 14A1 has width of face equal to the width of recording track. That is, the width of face in the 1st medium opposed face ABS of partial 14 A<SUB>1 has specified the width of recording track. The width of face of the 2nd part 14A2 is equal to the width of face of the 1st part 14A1, and after it becomes large gradually so that it keeps away from the location from the medium opposed face ABS, it has fixed magnitude in the boundary location with the 1st part 14A1. the 2nd part 14A2 of magnetic pole partial layer 14A -- yoke partial layer 14B -- the 1st layer lapped on [ some ] the medium opposed face ABS side of 14B1, and the part by the side of the medium opposed face ABS of 2nd layer 14 B-2s of yoke partial layer 14B has lapped through the non-magnetic layer 15 on the 2nd part 14A2 of magnetic pole partial layer 14A.

[0075] The width of face in the medium opposed face ABS of the 1st part 14A1, i.e., the width of recording track, is 0.5 micrometers or less preferably, and it is 0.3 micrometers or less still more preferably. The width of face of the 2nd part 14A2 in the part which laps with yoke partial layer 14B is larger than the width of face in the medium opposed face ABS of the 1st part 14A1, for example, is 2 micrometers or more.

[0076] The edge by the side of the medium opposed face ABS of 2nd layer 14 B-2s of yoke partial layer 14B is the location which separated 1.5 micrometers or more from the medium opposed face ABS, for example, and is arranged in the location near the medium opposed face ABS rather than the back end side of magnetic pole partial layer 14A.

[0077] Moreover, with the gestalt of this operation, the 1st layer of the edge of an opposite hand is arranged in the location distant from the medium opposed face ABS rather than the magnetic connection section of 14B1 and the 1st magnetic layer 8 with the medium opposed face ABS of 2nd layer 14 B-2s of yoke partial layer 14B.

[0078] The saturation magnetic flux density of magnetic pole partial layer 14A has become more than the saturation magnetic flux density of yoke partial layer 14B. As a magnetic material which constitutes magnetic pole partial layer 14A, it is desirable that saturation magnetic flux density uses the high saturation-magnetic-flux-density material beyond 1.4T. The ingredient containing the ingredient, the iron, and the nickel element which contain the ingredient containing iron and a nitrogen atom, iron, a zirconia, and an oxygen atom as high saturation-magnetic-flux-density material etc. can be used. Specifically as high saturation-magnetic-flux-density material, at least one kind in in NiFe (nickel:45 % of the weight, Fe:55 % of the weight), FeN, its compound, Co system amorphous alloy, Fe-Co, Fe-M (O (oxygen atom) is also included if needed.), and Fe-Co-M (O (oxygen atom) is also included if needed.) can be used, for example. Here, M is at least one kind chosen from nickel, N, C, B, Si, aluminum, Ti, Zr, Hf, Mo, Ta, Nb, and Cu (all are chemical symbols).

[0079] As a magnetic material which constitutes yoke partial layer 14B, saturation magnetic flux density can use the ingredient containing the iron and the nickel element used as about 1.0T, for example. Such an ingredient is high resistance from the ingredient which is excellent in corrosion resistance and constitutes magnetic pole partial layer 14A. Moreover, formation of yoke partial layer 14B becomes easy by using such an ingredient.

[0080] Moreover, the thing of the presentation system same as a magnetic material which constitutes yoke partial layer 14B as the magnetic material which constitutes magnetic pole partial layer 14A can also be used. In this case, in order to make saturation magnetic flux density of yoke partial layer 14B smaller than the saturation magnetic flux density of magnetic pole partial layer 14A, as a magnetic material which constitutes yoke partial layer 14B, it is desirable to use the small ingredient of the presentation ratio of an iron atom compared with the magnetic material which constitutes magnetic pole partial layer 14A.

[0081] The superficial configuration of a non-magnetic layer 15 is the same as that of magnetic pole partial layer 14A. Moreover, the non-magnetic layer 15 is exposed to the medium opposed face ABS. The thickness of a non-magnetic layer 15 is 0.5 micrometers or less preferably. Here, thickness of a non-magnetic layer 15 is set to 0.3 micrometers as an example. Moreover, a non-magnetic layer 15 can also be excluded.

[0082] As an ingredient which constitutes a non-magnetic layer 15, the non-conductive non-magnetic material containing titanium or a tantalum of inorganic systems, such as an ingredient (an alloy and an oxide are included.), an alumina, and a silicon oxide (SiO2), can be used, for example. Moreover, when forming magnetic pole partial layer 14A by dry etching, it is desirable to use the ingredient with the etch rate smaller than the ingredient which constitutes magnetic pole partial layer 14A, and the ingredient which constitutes insulating-layer 9C which touches magnetic pole partial layer 14A of the gap layers 9 to dry etching as an

ingredient which constitutes a non-magnetic layer 15. As such an ingredient, the ingredient (an alloy and an oxide are included.) which contains titanium or a tantalum, for example can be used.
[0083] As shown in drawing 4 and drawing 5 , a rectangle is sufficient as the configuration of the field of magnetic pole partial layer 14A exposed to the medium opposed face ABS, and a trapezoid smaller than a top chord or a triangle is sufficient as the lower side arranged at the backside [ the travelling direction T of a record medium ] (air inflow one end in a slider). Moreover, a concave surface is sufficient as the side face of magnetic pole partial layer 14A. Moreover, the include angle of the side side in the field of magnetic pole partial layer 14A exposed to the medium opposed face ABS and the field of a substrate 1 to make has desirable 80-88 degrees.
[0084] As explained above, the thin film magnetic head concerning the gestalt of this operation is equipped with the medium opposed face ABS, the reproducing head, and the recording head which counter a record medium. The reproducing head is equipped with the lower shielding layer 3 and the up shielding layer 6 for shielding the MR component 5 as a playback component, and the MR component 5 arranged so that the part by the side of the medium opposed face ABS may counter on both sides of the MR component 5.
[0085] While a recording head contains the magnetic pole part arranged so that predetermined spacing may be opened before and behind the travelling direction T of a record medium and the medium opposed face ABS side may be countered mutually The 1st magnetic layer 8 and 2nd magnetic layer 14 which were magnetically connected in the location distant from the medium opposed face ABS, It consisted of a non-magnetic material and has the gap layer 9 prepared between the 1st magnetic layer 8 and the 2nd magnetic layer 14, and the thin film coil 10 with which the part [ at least ] was prepared in the condition of having insulated to these magnetic layers 8 and 14 between the 1st magnetic layer 8 and the 2nd magnetic layer 14.
[0086] With the gestalt of this operation, the field by the side of the 2nd magnetic layer 14 of the part arranged among magnetic layers 8 and 14 among the thin film coils 10 (field of the upside in drawing 1 ) is arranged in the location by the side of the 1st magnetic layer 8 (under [ in drawing 1 ]) rather than the location of the edge by the side of the 2nd magnetic layer 14 of the gap layer 9 in the medium opposed face ABS (edge of the upside in drawing 1 ).
[0087] Moreover, the width of face in the medium opposed face ABS serves as magnetic pole partial layer 14A which specifies the width of recording track, and a yoke part including a magnetic pole part, and the 2nd magnetic layer 14 has yoke partial layer 14B which connects magnetically magnetic pole partial layer 14A and the 1st magnetic layer 8. The saturation magnetic flux density of magnetic pole partial layer 14A has become more than the saturation magnetic flux density of yoke partial layer 14B. Yoke partial layer 14B is magnetically connected to magnetic pole partial layer 14A in the field by the side of the gap layer 9 of magnetic pole partial layer 14A, the back end side, and the crosswise both-sides side at least.
[0088] The thin film magnetic head concerning the gestalt of this operation is suitable for using for vertical magnetic recording. When using this thin film magnetic head for vertical magnetic recording, the 1st part 14A1 in magnetic pole partial layer 14A of the 2nd magnetic layer 14 serves as the main pole, and the magnetic pole part of the 1st magnetic layer 8 serves as an auxiliary magnetic pole. In addition, when using the thin film magnetic head concerning the gestalt of this operation for vertical magnetic recording, it is possible to use both a two-layer medium and a monolayer medium as a record medium.
[0089] In the thin film magnetic head concerning the gestalt of this operation, the 2nd magnetic layer 14 has magnetic pole partial layer 14A and yoke partial layer 14B. The field by the side of a part of [ at least ] 2nd magnetic layer 14 of the thin film coil 10 It is arranged in the location by the side of the 1st magnetic layer 8 rather than the location of the edge by the side of the 2nd magnetic layer 14 of the gap layer 9 in the medium opposed face ABS. Yoke partial layer 14B In the field by the side of the gap layer 9 of magnetic pole partial layer 14A, the back end side, and the crosswise both-sides side, it connects magnetically to magnetic pole partial layer 14A at least. Therefore, with the gestalt of this operation, it becomes possible for yoke partial layer 14B to be able to form a short magnetic path between the magnetic connection sections and magnetic pole partial layer 14A to the 1st magnetic layer 8, and to arrange yoke partial layer 14B near the thin film coil 10.
[0090] Moreover, with the gestalt of this operation, the saturation magnetic flux density of magnetic pole partial layer 14A is more than the saturation magnetic flux density of yoke partial layer 14B. Furthermore, yoke partial layer 14B is magnetically connected to magnetic pole partial layer 14A in the field by the side of the gap layer of magnetic pole partial layer 14A, the back end side, and the crosswise both-sides side at least. That is, the area for a magnetic connection of yoke partial layer 14B and magnetic pole partial layer 14A is large. Therefore, according to the gestalt of this operation, the saturation of the magnetic flux in the middle of the 2nd magnetic layer 14 can be prevented.

[0091] according to the gestalt of this operation from these things -- electromagnetism -- it becomes possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from the magnetic pole part of the 2nd magnetic layer 14, and to shorten magnetic-path length, and to raise a RF property. When high saturation-magnetic-flux-density material is used for magnetic pole partial layer 14A, especially, the field of a direction vertical to the field of a record medium can be enlarged, and record to the big record medium of coercive force also becomes possible.
[0092] Moreover, in the thin film magnetic head concerning the gestalt of this operation, the field of a direction vertical to the field of a record medium is larger than the field of a longitudinal direction, can be efficient and can transmit the magnetic energy which a head generates to a record medium. Therefore, according to this thin film magnetic head, effect of heat fluctuation of a record medium can be made hard to be influenced, and track recording density can be raised.
[0093] As shown in drawing 1 , as for the thin film magnetic head concerning the gestalt of this operation, it is desirable to arrange the 1st magnetic layer 8 to the backside [ the travelling direction T of a record medium ] (air inflow one end in the slider containing the thin film magnetic head), and to arrange the 2nd magnetic layer 14 to a before [ the travelling direction T of a record medium ] side (air runoff one end in the slider containing the thin film magnetic head). By considering as such arrangement, the flux reversal transition width of face in the record medium at the time of using vertical magnetic recording compared with this in arrangement of reverse can become small, and the magnetization pattern of high density can be formed more in a record medium, consequently track recording density can be raised.
[0094] moreover, as shown in drawing 1 , in the thin film magnetic head concerning the gestalt of this operation yoke partial layer 14B touched the field by the side of the 1st magnetic layer 8 and the gap layer 9 of magnetic pole partial layer 14A, and was magnetically connected to these -- with 14B1 the 1st layer The 1st layer touches the back end side of 14B1 and magnetic pole partial layer 14A, and a crosswise both-sides side, and 2nd layer 14 B-2s magnetically connected to these are included. Thereby, formation of yoke partial layer 14B becomes easy.
[0095] Moreover, 2nd layer 14 B-2s of yoke partial layer 14B are further connected magnetically [ the gap layer 9 of magnetic pole partial layer 14A ] to the field of an opposite hand. thereby -- the gap layer 9 of magnetic pole partial layer 14A -- from the field of an opposite hand -- magnetic pole partial layer 14A from 2nd layer 14 B-2s of yoke partial layer 14B -- magnetic flux -- it can lead -- consequently, electromagnetism -- conversion efficiency can be raised.
[0096] Moreover, as shown in drawing 1 , in the thin film magnetic head concerning the gestalt of this operation, the 1st layer of each edge by the side of the medium opposed face ABS of 14B1 and 2nd layer 14 B-2s is arranged in the location of yoke partial layer 14B distant from the medium opposed face ABS. Thereby, it can prevent that informational writing arises in a record medium by the field of yoke partial layer 14B generated the 1st layer from each edge by the side of the medium opposed face ABS of 14B1 and 2nd layer 14 B-2s.
[0097] Moreover, as shown in drawing 2 , in the thin film magnetic head concerning the gestalt of this operation, the width of face of the part which touches yoke partial layer 14B of magnetic pole partial layer 14A is larger than the width of face in the medium opposed face ABS of magnetic pole partial layer 14A. Area of the part which touches yoke partial layer 14B of magnetic pole partial layer 14A can be enlarged by this, and the saturation of the magnetic flux in this part can be prevented. Consequently, the field impressed to a record medium can be enlarged by being able to lead magnetic flux to magnetic pole partial layer 14A from yoke partial layer 14B efficiently, and making small exposure area in the medium opposed face ABS of magnetic pole partial layer 14A.
[0098] Moreover, in the thin film magnetic head concerning the gestalt of this operation, without enlarging the thickness and width of face of magnetic pole partial layer 14A by setting die length from the medium opposed face ABS to the back end side of magnetic pole partial layer 14A to 2 micrometers or more, area of the part which touches yoke partial layer 14B of magnetic pole partial layer 14A can be enlarged, and the saturation of the magnetic flux in this part can be prevented. Consequently, magnetic flux can be efficiently led to magnetic pole partial layer 14A from yoke partial layer 14B.
[0099] Moreover, as shown in drawing 1 , in the thin film magnetic head concerning the gestalt of this operation, it has the non-magnetic layer 15 which touches the field of an opposite hand in the gap layer 9 of magnetic pole partial layer 14A. Thereby, when forming magnetic pole partial layer 14A by dry etching, or in case yoke partial layer 14B is formed with electroplating, in the gap layer 9 of magnetic pole partial layer 14A, the field of an opposite hand can prevent receiving a damage and can make the field flat. Especially, with the gestalt of this operation, since the non-magnetic layer 15 is exposed to the medium opposed face

ABS, in the medium opposed face ABS, the edge of an opposite hand can be kept flat in the gap layer 9 of magnetic pole partial layer 14A. Thereby, the field generated from magnetic pole partial layer 14A in the medium opposed face ABS can be equalized about the direction which intersects a truck. Consequently, distortion of the bit pattern configuration in a record medium can be suppressed, and track recording density can be raised.

[0100] Moreover, with the gestalt of this operation, through the non-magnetic layer 15, the part by the side of the medium opposed face ABS of yoke partial layer 14B, i.e., the part by the side of the medium opposed face ABS of 2nd layer 14 B-2s, adjoins the field of an opposite hand, and it is magnetically connected to magnetic pole partial layer 14A through the non-magnetic layer 15 in the gap layer 9 of magnetic pole partial layer 14A. Consequently, magnetic flux can be led to the medium opposed face ABS side of magnetic pole partial layer 14A also from a part of yoke partial layer 14B through a non-magnetic layer 15.

[0101] Moreover, when constituted from an ingredient with the etch rate smaller than the ingredient which constitutes the part which touches magnetic pole partial layer 14A of the ingredient which constitutes magnetic pole partial layer 14A, and the gap layers 9 in a non-magnetic layer 15 to dry etching, in case magnetic pole partial layer 14A is formed by dry etching, the gap layer 9 of magnetic pole partial layer 14A can prevent that the field of an opposite hand receives a damage.

[0102] Moreover, as shown in drawing 1 , in the thin film magnetic head concerning the gestalt of this operation, the part arranged between the 1st magnetic layer 8 and the 2nd magnetic layer 14 among the thin film coils 10 is arranged in the location near [ location / with magnetic pole partial layer 14A of the 1st magnetic layer 8 and the 2nd magnetic layer 14 / middle ] the 1st magnetic layer 8. Thereby, by the 1st magnetic layer 8 with the bigger volume than the 2nd magnetic layer 14, the field generated from the thin film coil 10 can be absorbed efficiently, and the absorption coefficient of the field in the 1st magnetic layer 8 and 2nd magnetic layer 14 can be raised compared with the case where the thin film coil 10 is close to the 2nd magnetic layer 14.

[0103] moreover, as shown in drawing 1 , in the thin film magnetic head concerning the gestalt of this operation The 1st part which the gap layer 9 consists of an ingredient which has a fluidity at the time of formation, is filled up between the coils of the thin film coil 10 at least, and is not exposed to the medium opposed face ABS (insulating-layer 9B), It consists of an ingredient in which corrosion resistance, rigidity, and insulation excelled this 1st part, and has the 2nd part (insulating layers 9A and 9C) exposed to the medium opposed face ABS. the 1st part (insulating-layer 9B) -- the 2nd part (insulating layers 9A and 9C) and yoke partial layer 14B -- the 1st layer is thoroughly covered with 14B1. It is easy to be filled up with a non-magnetic material that there is no clearance between the coils of the thin film coil 10, when the non-magnetic material which has a fluidity like the ingredient of an organic system is used by the sputtering method, although it is difficult. However, the ingredient of an organic system is lacking in dependability in respect of the resistance over dry etching, corrosion resistance, thermal resistance, rigidity, etc. With the ingredient formed the 1st part (insulating-layer 9B) with which it filled up between the coils of the thin film coil 10, and corrosion resistance, rigidity, and insulation excelled [ ingredient ] this 1st part in the gestalt of this operation as mentioned above with the ingredient which has a fluidity at the time of formation Since the 2nd part (insulating layers 9A and 9C) which exposes a part of 1st part to a bonnet and the medium opposed face ABS was formed, it can be filled up with a non-magnetic material that there is no clearance between the coils of the thin film coil 10, and the dependability of the gap layer 9 can be raised.

[0104] Moreover, the thin film magnetic head concerning the gestalt of this operation is equipped with the MR component 5 as a playback component. thereby -- an induction type -- electromagnetism -- the playback engine performance can be raised compared with the case where it reproduces using a sensing element. Moreover, since the MR component 5 is shielded by the shielding layers 3 and 6, it can raise the resolution at the time of playback.

[0105] Next, with reference to drawing 6 , the modification of the thin film magnetic head concerning the gestalt of this operation is explained. Drawing 6 is the sectional view showing the configuration of the thin film magnetic head of a modification. In addition, drawing 6 shows the medium opposed face and the cross section vertical to the field of a substrate.

[0106] The thin film magnetic head of this modification excludes the up shielding layer 6 and non-magnetic layer 7 in the thin film magnetic head shown in drawing 1 , and the 1st magnetic layer 8 serves as the up shielding layer 6. According to this configuration, the structure of the thin film magnetic head becomes easy, and manufacture also becomes easy. The configuration of others of the thin film magnetic head of this modification is the same as that of the thin film magnetic head shown in drawing 1 .

[0107] Next, with reference to drawing 7 thru/or drawing 22 , the manufacture approach of the thin film

magnetic head concerning the gestalt of this operation is explained. In addition, although the manufacture approach is explained taking the case of the case where the thin film magnetic head shown in drawing 1 is manufactured here, when manufacturing the thin film magnetic head shown in drawing 6 , it is also the same as that of the following explanation except the process which forms the up shielding layer 6 and a non-magnetic layer 7 being skipped.

[0108] By the manufacture approach of the thin film magnetic head concerning the gestalt of this operation, an insulating layer 2 is first formed on a substrate 1. Next, the lower shielding layer 3 is formed on an insulating layer 2. In addition, in drawing 7 thru/or drawing 22 , the substrate 1 and the insulating layer 2 are omitted.

[0109] Next, as shown in drawing 7 , the insulator layer which becomes a part of insulating layer 4 is formed on the lower shielding layer 3, and the lead which is connected to the MR component 5 and this MR component 5 on this insulator layer and which is not illustrated is formed. Next, a bonnet, the MR component 5, and a lead are laid underground in an insulating layer 4 by the new insulator layer which becomes a part of other insulating layers 4 about the MR component 5 and a lead.

[0110] Next, the up shielding layer 6 is formed on an insulating layer 4, and a non-magnetic layer 7 is formed on it. Next, the 1st magnetic layer 8 is formed on this non-magnetic layer 7 at a predetermined configuration. Next, although not illustrated, a non-magnetic material is ground until a bonnet and the 1st magnetic layer 8 expose a non-magnetic layer 7 and the 1st magnetic layer 8 by non-magnetic materials, such as an alumina, and flattening of the top face of the 1st magnetic layer 8 is carried out.

[0111] Next, as shown in drawing 8 , on the 1st magnetic layer 8, the spatter of the ingredient non-conductive [, such as an alumina, ] and nonmagnetic is carried out, and insulating-layer 9A is formed. Next, in the location which should connect the 1st magnetic layer 8 and the 2nd magnetic layer 14 mentioned later, contact hole 9a is formed in insulating-layer 9A using a well-known photolithography technique and a well-known dry etching technique.

[0112] Next, as shown in drawing 9 , the thin film coil 10 is formed on insulating-layer 9A using a well-known photolithography technique and a well-known membrane formation technique (for example, electroplating).

[0113] Next, as shown in drawing 10 , insulating-layer 9B with which it fills up between the coils of the thin film coil 10 at least is formed using a well-known photolithography technique. Here, insulating-layer 9B is formed so that the thin film coil 10 may be covered thoroughly, but after forming insulating-layer 9B with which it fills up between the coils of the thin film coil 10, apart from insulating-layer 9B, a wrap insulating layer may be formed for the thin film coil 10 and insulating-layer 9B.

[0114] next, the medium opposed face ABS from the location in which contact hole 9a was formed using a well-known photolithography technique and a well-known membrane formation technique (for example, electroplating) as shown in drawing 11 -- turning -- up to a position -- a 1st magnetic layer 8 and insulating-layer 9B top -- yoke partial layer 14B -- 14B1 [ layer / 1st ] is formed. For thickness, at this event, the 1st layer of 2-10 micrometers and width of face of the configuration of 14B1 are [ 3 micrometers or more and depth (lay length vertical to the medium opposed face ABS) ] 5-20 micrometers.

[0115] next, it was shown in drawing 12 -- as -- a spatter -- using -- the 1st of insulating-layer 9A, insulating-layer 9B, and yoke partial layer 14B -- layer 14B1 -- a wrap -- insulating-layer 9C is formed like. At this event, the 1st layer of the thickness of insulating-layer 9C is carried out to more than the thickness of 14B1.

[0116] next, it was shown in drawing 13 -- as -- for example, chemical machinery polish -- using -- yoke partial layer 14B -- until 14B1 [ layer / 1st ] is exposed -- the front face of insulating-layer 9C -- grinding -- insulating-layer 9C -- and flattening of the top face of 14B1 is carried out the 1st layer. At this event, distance from the top face of the 1st magnetic layer 8 to the top face of insulating-layer 9C is set to 3-6 micrometers.

[0117] next, as shown in drawing 14 , the 1st layer consists of insulating-layer 9C and an ingredient which constitutes magnetic pole partial layer 14A of the 2nd magnetic layer 14 on 14B1 -- -ed -- etching layer 14Ae is formed. -ed -- thickness of etching layer 14Ae is preferably set to 0.1-0.8 micrometers, and is set to 0.3-0.8 micrometers still more preferably. -ed -- electroplating is sufficient as the formation approach of etching layer 14Ae -- it may carry out and a spatter is sufficient. -ed -- case the granularity of the front face of etching layer 14Ae is large -- (for example, when arithmetic mean granularity Ra is 12A or more) chemical machinery polish etc. -- -ed -- it is desirable to grind and carry out flattening of the front face of etching layer 14Ae.

[0118] next -- -ed -- non-magnetic layer 15e is formed on etching layer 14Ae. Thickness of non-magnetic

layer 15e is preferably set to 0.5 micrometers or less.
[0119] Next, although not illustrated, the electrode layer for electroplating is formed by the spatter on non-magnetic layer 15e. Set thickness of this electrode layer to 0.1 micrometers or less, and let an ingredient be an iron nickel alloy.
[0120] Next, as shown in drawing 15 , the resist frame 31 which has the opening section corresponding to the configuration of magnetic pole partial layer 14A by the photoresist is formed on the above-mentioned electrode layer using a photolithography technique. Next, the plating film used as the mask 32 corresponding to the configuration of magnetic pole partial layer 14A is formed on the above-mentioned electrode layer with electroplating (the frame galvanizing method) using this resist frame 31. Set thickness of this plating film to 1-4 micrometers, and let an ingredient be an iron nickel alloy. Next, the resist frame 31 is removed.
[0121] next, it was shown in drawing 16 -- as -- a mask 32 -- using -- dry etching techniques, such as ion milling, -- non-magnetic layer 15e -- and -- -ed -- etching layer 14Ae is etched and a non-magnetic layer 15 and magnetic pole partial layer 14A are formed. Although removing thoroughly is desirable among masks 32 at this time as for the part corresponding to the medium opposed face ABS at least, a mask 32 will be nonmagnetic, and it will not be this limitation if there is dependability of enough in respect of corrosion resistance etc.
[0122] A rectangle or the lower side arranged at the backside [ the travelling direction T of a record medium ] (air inflow one end in a slider) makes the configuration of the field of magnetic pole partial layer 14A exposed to the medium opposed face ABS by the above-mentioned etching as shown in drawing 4 and drawing 5 a trapezoid or a triangle smaller than a top chord. Moreover, a concave surface is sufficient as the side face of magnetic pole partial layer 14A. Moreover, you may prescribe that the width of face of magnetic pole partial layer 14A in the medium opposed face ABS is in agreement with the specification of the width of recording track by the above-mentioned etching.
[0123] moreover, that a non-magnetic layer 15 and magnetic pole partial layer 14A are formed of the above-mentioned etching, simultaneously yoke partial layer 14B -- 14B1 [ layer / 1st ] is exposed.
[0124] In addition, instead of forming the mask 32 by the plating film as mentioned above, a photolithography technique may be used and the resist pattern corresponding to the configuration of magnetic pole partial layer 14A may be formed by the photoresist on non-magnetic layer 15e. and this resist pattern -- a mask -- carrying out -- non-magnetic layer 15e -- and -- -ed -- while etching etching layer 14Ae and forming a non-magnetic layer 15 and magnetic pole partial layer 14A -- yoke partial layer 14B -- 14B1 [ layer / 1st ] may be exposed and a resist pattern may be removed after that.
[0125] Next, as shown in drawing 17 , the wrap resist covering 33 is formed for the part by the side of the medium opposed face ABS in magnetic pole partial layer 14A and a non-magnetic layer 15 by the photoresist using a photolithography technique. As for the thickness of this resist covering 33, it is desirable to carry out to below the thickness of the frame for yoke partial stratification mentioned later.
[0126] Next, as shown in drawing 18 , the 1st layer of the electrode layer 34 of electroplating of the resist covering 33, magnetic pole partial layer 14A (and non-magnetic layer 15), and yoke section slice 14B which is a sake is formed by the spatter on 14B1. Thickness of this electrode layer 34 is set to 0.1 micrometers or less, and an ingredient may be used as an iron nickel alloy and may form Ti (titanium) on a substrate.
[0127] Next, as shown in drawing 19 , the resist frame 35 which has the opening section corresponding to the configuration of 2nd layer 14 B-2s of yoke partial layer 14B by the photoresist is formed on the electrode layer 34.
[0128] Next, as shown in drawing 20 , 2nd layer 14 B-2s of yoke partial layer 14B are formed on the electrode layer 34 with electroplating (the frame galvanizing method) using the resist frame 35. Next, the resist frame 35 is removed. In addition, although they are possible also for forming using the lift-off method, in order to make the configuration of 2nd layer 14 B-2s follow the configuration of a substrate, it is most desirable [ 2nd layer 14 B-2s ] to use electroplating.
[0129] Next, as shown in drawing 21 , parts other than the part which exists among the electrode layers 34 under 2nd layer 14 B-2s of yoke partial layer 14B are removed by dry etching.
[0130] Next, as shown in drawing 22 , the resist covering 33 is removed. Next, a protective layer 17 is formed so that the 2nd magnetic layer 14 may be covered. Next, wiring, a terminal, etc. are formed on a protective layer 17, a substrate is cut per slider, polish of the medium opposed face ABS, production of the rail for floatation, etc. are performed, and the thin film magnetic head is completed.
[0131] Thus, the manufacture approach of the thin film magnetic head concerning the gestalt of this operation The process which forms the 1st magnetic layer 8, and the field by the side of a part of [ at least ]

2nd magnetic layer 14 of the thin film coil 10 It is arranged in the location by the side of the 1st magnetic layer 8 rather than the location of the edge by the side of the 2nd magnetic layer 14 of the gap layer 9 in the medium opposed face ABS. And yoke partial layer 14B sets at least to the field by the side of the gap layer 9 of magnetic pole partial layer 14A, a back end side, and a crosswise both-sides side. It has the process which forms the gap layer 9, the thin film coil 10, and the 2nd magnetic layer 14 on the 1st magnetic layer 8 so that it may connect magnetically to magnetic pole partial layer 14A. According to the manufacture approach of this thin film magnetic head, the same operation as the thin film magnetic head concerning the gestalt of this operation and effectiveness are acquired.

[0132] moreover, by the manufacture approach of the thin film magnetic head concerning the gestalt of this operation The process which forms the gap layer 9, the thin film coil 10, and the 2nd magnetic layer 14 on the 1st magnetic layer 8 The process which forms insulating-layer 9B which insulates this thin film coil 10 with the thin film coil 10 to a perimeter, and which is a part of gap layer 9 on the 1st magnetic layer 8, On the 1st magnetic layer 8 and insulating-layer 9B, the process of yoke partial layer 14B which forms 14B1 [ layer / 1st ], Until 14B1 [ layer / 1st ] is exposed with the process which forms 1st magnetic layer 8, insulating-layer 9B, and insulating-layer that are a part of other gap layers 9 on 14B1 1st layer 9C The process which grinds insulating-layer 9C and carries out flattening of the 1st layer of the top face of 14B1 and insulating-layer 9C, the 1st layer consists of an ingredient by which flattening was carried out and which constitutes magnetic pole partial layer 14A on 14B1 and insulating-layer 9C -- -ed -- with the process which forms etching layer 14Ae Etching layer 14Ae is selectively etched by dry etching. -ed -- The process at which 14B1 [ layer / 1st ] is exposed while determining the appearance of magnetic pole partial layer 14A which touches 14B1 the 1st layer, and the process which forms the 1st layer of 2nd layer 14 B-2s of yoke partial layer 14B on 14B1 are included.

[0133] Thus, since according to the gestalt of this operation 2nd layer 14 B-2s of yoke partial layer 14B are formed after [ yoke partial layer 14B ] forming 14B1 [ layer / 1st ] and forming magnetic pole partial layer 14A before forming magnetic pole partial layer 14A It becomes possible to form easily yoke partial layer 14B magnetically connected to magnetic pole partial layer 14A in the field by the side of the gap layer 9 of magnetic pole partial layer 14A, a back end side, and a crosswise both-sides side at least.

[0134] moreover -- according to the gestalt of this operation -- -ed -- before the process which forms etching layer 14Ae -- polish -- -ed -- insulating-layer 9C used as the substrate of etching layer 14Ae, and yoke partial layer 14B -- flattening of the top face of 14B1 is carried out the 1st layer. Thereby, in the medium opposed face ABS, flattening of the edge by the side of the gap layer 9 of magnetic pole partial layer 14A can be carried out. moreover -- -ed -- the case where etching layer 14Ae is formed by the spatter -- -ed -- since the thickness homogeneity at the time of membrane formation of etching layer 14Ae is good, in the medium opposed face ABS, flattening also of the edge of an opposite hand can be carried out in the gap layer 9 of magnetic pole partial layer 14A. From these things, the field generated from magnetic pole partial layer 14A in the medium opposed face ABS can be equalized about the direction which intersects a truck, consequently distortion of the bit pattern configuration in a record medium can be suppressed, and track recording density can be raised.

[0135] moreover, the gestalt of this operation -- setting -- -ed -- after the process which forms etching layer 14Ae -- polish -- -ed -- when flattening of the top face of etching layer 14Ae is carried out, in the medium opposed face ABS, flattening of the edge of an opposite hand can be thoroughly carried out in the gap layer 9 of magnetic pole partial layer 14A. The field generated from magnetic pole partial layer 14A in the medium opposed face ABS can be equalized by this about the direction which intersects a truck, consequently distortion of the bit pattern configuration in a record medium can be suppressed, and track recording density can be raised.

[0136] In the gestalt of this operation, moreover, the process which forms magnetic pole partial layer 14A -ed -- after the process which forms etching layer 14Ae -- -ed -- with the process which forms non-magnetic layer 15e on etching layer 14Ae the process which forms the mask 32 corresponding to the configuration of magnetic pole partial layer 14A on non-magnetic layer 15e -- containing -- -ed -- the process which etches etching layer 14Ae -- this mask 32 -- using -- non-magnetic layer 15e -- and -- -ed -- etching layer 14Ae may be etched. in this case -- -ed -- where the top face of etching layer 14Ae is protected by non-magnetic layer 15e, the appearance of magnetic pole partial layer 14A can be determined, and it becomes possible in the gap layer 9 of magnetic pole partial layer 14A to maintain the surface smoothness of the edge of an opposite hand.

[0137] Moreover, the process which forms a mask 32 may form the resist frame 31 which has the opening section corresponding to the configuration of magnetic pole partial layer 14A on non-magnetic layer 15e,

and may form a mask 32 in the opening circles of this resist frame 31. In this case, it becomes possible to form the mask 32 excellent in the resistance over dry etching compared with the case where a mask 32 is formed by the resist. Even when the ingredient which constitutes magnetic pole partial layer 14A is excellent in the resistance over dry etching by this, it becomes possible to determine the appearance of magnetic pole partial layer 14A by the dry etching which used the mask 32.
[0138] Moreover, in the gestalt of this operation, 2nd layer 14 B-2s of yoke partial layer 14B may be formed with electroplating. In this case, while being able to form 2nd layer 14 B-2s easily, it becomes possible to form 2nd layer 14 B-2s in the configuration where it followed well in the configuration of that substrate.
[0139] Moreover, the process which forms 2nd layer 14 B-2s of yoke partial layer 14B The process which forms the wrap resist covering 33 for the part by the side of the medium opposed face ABS of magnetic pole partial layer 14A, The process of the resist covering 33, magnetic pole partial layer 14A (and non-magnetic layer 15), and yoke partial layer 14B which forms the 1st layer of the electrode layer 34 for electroplating on 14B1, You may also include the process which forms 2nd layer 14 B-2s with electroplating using the electrode layer 34. In this case, it can prevent an electrode layer adhering to some side faces by the side of the medium opposed face ABS of magnetic pole partial layer 14A, and remaining on them, and can prevent that the width of recording track becomes large by adhesion of an electrode layer and residual. Furthermore, in case dry etching removes an electrode layer, it can also prevent that the etched ingredient adheres to some side faces by the side of the medium opposed face ABS of magnetic pole partial layer 14A, remains, and the dependability of the thin film magnetic head falls.
[0140] With reference to [the gestalt of the 2nd operation] next drawing 23 , and drawing 24 , the thin film magnetic head concerning the gestalt of operation of the 2nd of this invention is explained. Drawing 23 is the sectional view showing the configuration of the thin film magnetic head concerning the gestalt of this operation. In addition, drawing 23 shows the medium opposed face and the cross section vertical to the field of a substrate. Moreover, the arrow head shown with Notation T in drawing 23 expresses the travelling direction of a record medium. Drawing 24 is the perspective view showing the important section of the thin film magnetic head shown in drawing 23 .
[0141] the gestalt of the 1st operation with the gestalt of this operation -- comparing -- yoke partial layer 14B -- the 1st layer of the thickness of 14B1 is small. it can set in the location of contact hole 9a -- the 1st layer of the thickness of 14B1 has turned into below the thickness of the sum total of insulating-layer 9A and insulating-layer 9B. However, as for the thickness of 14B1, it is desirable that it is 1 micrometers or more in the location of contact hole 9a the 1st layer.
[0142] Moreover, with the gestalt of this operation, 14B1 is prolonged by 2 micrometers or more from the magnetic connection section with the 1st magnetic layer 8 the 1st layer in the direction of yoke partial layer 14B which separates from the medium opposed face ABS. It is desirable to extend [ of yoke partial layer 14B ] 14B1 also on crosswise both sides further the 1st layer with the gestalt of this operation.
[0143] Moreover, with the gestalt of this operation, the 1st layer of the edge of an opposite hand is arranged in the location near the medium opposed face ABS rather than the magnetic connection section of 14B1 and the 1st magnetic layer 8 with the medium opposed face ABS of 2nd layer 14 B-2s of yoke partial layer 14B. However, with the medium opposed face ABS of 2nd layer 14 B-2s, the edge of an opposite hand is arranged in the location which is distant from the medium opposed face ABS from the location of the edge of an opposite hand with the medium opposed face ABS of magnetic pole partial layer 14A, and is preferably arranged from the medium opposed face ABS in the location from which 10 micrometers or more were separated.
[0144] Next, with reference to drawing 25 thru/or drawing 36 , the manufacture approach of the thin film magnetic head concerning the gestalt of this operation is explained.
[0145] As shown in drawing 10 by the manufacture approach of the thin film magnetic head concerning the gestalt of this operation, the process which forms the thin film coil 10 and insulating-layer 9B on insulating-layer 9A is the same as the gestalt of the 1st operation.
[0146] the gestalt of this operation next showed to drawing 25 -- as -- a well-known photolithography technique and a well-known membrane formation technique (for example, electroplating) -- using -- a 1st magnetic layer 8 and insulating-layer 9B top -- yoke partial layer 14B -- 14B1 [ layer / 1st ] is formed. For thickness, at this event, the 1st layer of 2-10 micrometers and width of face of the configuration of 14B1 are [ 1-4 micrometers and depth ] 5-20 micrometers.
[0147] next, it was shown in drawing 26 -- as -- a spatter -- using -- the 1st of insulating-layer 9A, insulating-layer 9B, and yoke partial layer 14B -- layer 14B1 -- a wrap -- insulating-layer 9C is formed like. At this event, the 1st layer of the thickness of insulating-layer 9C is carried out to more than the thickness of

14B1.
[0148] next, it was shown in drawing 27 -- as -- for example, chemical machinery polish -- using -- yoke partial layer 14B -- until 14B1 [ layer / 1st ] is exposed and the thickness of insulating-layer 9C becomes equal to predetermined record gap length -- the front face of insulating-layer 9C -- grinding -- insulating-layer 9C -- and flattening of the top face of 14B1 is carried out the 1st layer. At this event, distance from the top face of the 1st magnetic layer 8 to the top face of insulating-layer 9C is set to 3-6 micrometers.
[0149] next, as shown in drawing 28 , the 1st layer consists of insulating-layer 9C and an ingredient which constitutes magnetic pole partial layer 14A of the 2nd magnetic layer 14 on 14B1 -- -ed -- etching layer 14Ae is formed. -ed -- thickness of etching layer 14Ae is preferably set to 0.1-0.8 micrometers, and is set to 0.3-0.8 micrometers still more preferably. -ed -- electroplating is sufficient as the formation approach of etching layer 14Ae -- it may carry out and a spatter is sufficient. -ed -- case the granularity of the front face of etching layer 14Ae is large -- (for example, when arithmetic mean granularity Ra is 12A or more) chemical machinery polish etc. -- -ed -- it is desirable to grind and carry out flattening of the front face of etching layer 14Ae.
[0150] next -- -ed -- non-magnetic layer 15e is formed on etching layer 14Ae. Thickness of non-magnetic layer 15e is preferably set to 0.5 micrometers or less.
[0151] Next, although not illustrated, the electrode layer for electroplating is formed by the spatter on non-magnetic layer 15e. Set thickness of this electrode layer to 0.1 micrometers or less, and let an ingredient be an iron nickel alloy.
[0152] Next, as shown in drawing 29 , the resist frame 31 which has the opening section corresponding to the configuration of magnetic pole partial layer 14A by the photoresist is formed on the above-mentioned electrode layer using a photolithography technique. Next, the plating film used as the mask 32 corresponding to the configuration of magnetic pole partial layer 14A is formed on the above-mentioned electrode layer with electroplating (the frame galvanizing method) using this resist frame 31. Set thickness of this plating film to 1-4 micrometers, and let an ingredient be an iron nickel alloy. Next, the resist frame 31 is removed.
[0153] next, it was shown in drawing 30 -- as -- a mask 32 -- using -- dry etching techniques, such as ion milling, -- non-magnetic layer 15e -- and -- -ed -- etching layer 14Ae is etched and a non-magnetic layer 15 and magnetic pole partial layer 14A are formed. Although removing thoroughly is desirable among masks 32 at this time as for the part corresponding to the medium opposed face ABS at least, a mask 32 will be nonmagnetic, and it will not be this limitation if there is dependability of enough in respect of corrosion resistance etc. moreover, that a non-magnetic layer 15 and magnetic pole partial layer 14A are formed of this etching, simultaneously yoke partial layer 14B -- 14B1 [ layer / 1st ] is exposed.
[0154] In addition, instead of forming the mask 32 by the plating film as mentioned above, a photolithography technique may be used and the resist pattern corresponding to the configuration of magnetic pole partial layer 14A may be formed by the photoresist on non-magnetic layer 15e. and this resist pattern -- a mask -- carrying out -- non-magnetic layer 15e -- and -- -ed -- while etching etching layer 14Ae and forming a non-magnetic layer 15 and magnetic pole partial layer 14A -- yoke partial layer 14B -- 14B1 [ layer / 1st ] may be exposed and a resist pattern may be removed after that.
[0155] Next, as shown in drawing 31 , the wrap resist covering 33 is formed for the part by the side of the medium opposed face ABS in magnetic pole partial layer 14A and a non-magnetic layer 15 by the photoresist using a photolithography technique. As for the thickness of this resist covering 33, it is desirable to carry out to below the thickness of the frame for yoke partial stratification mentioned later.
[0156] Next, as shown in drawing 32 , the 1st layer of the electrode layer 34 of electroplating of the resist covering 33, magnetic pole partial layer 14A (and non-magnetic layer 15), and yoke section slice 14B which is a sake is formed by the spatter on 14B1. Thickness of this electrode layer 34 is set to 0.1 micrometers or less, and an ingredient may be used as an iron nickel alloy and may form Ti (titanium) on a substrate.
[0157] Next, as shown in drawing 33 , the resist frame 35 which has the opening section corresponding to the configuration of 2nd layer 14 B-2s of yoke partial layer 14B by the photoresist is formed on the electrode layer 34.
[0158] Next, as shown in drawing 34 , 2nd layer 14 B-2s of yoke partial layer 14B are formed on the electrode layer 34 with electroplating (the frame galvanizing method) using the resist frame 35. Next, the resist frame 35 is removed.
[0159] Next, as shown in drawing 35 , parts other than the part which exists among the electrode layers 34 under 2nd layer 14 B-2s of yoke partial layer 14B are removed by dry etching.
[0160] Next, as shown in drawing 36 , the resist covering 33 is removed. Next, a protective layer 17 is

formed so that the 2nd magnetic layer 14 may be covered. Next, wiring, a terminal, etc. are formed on a protective layer 17, a substrate is cut per slider, polish of the medium opposed face ABS, production of the rail for floatation, etc. are performed, and the thin film magnetic head is completed.
[0161] In addition, the up shielding layer 6 and a non-magnetic layer 7 are excluded, and you may make it the 1st magnetic layer 8 serve as the up shielding layer 6 also in the gestalt of this operation like the thin film magnetic head shown in drawing 6 . The configuration of others in the gestalt of this operation, an operation, and effectiveness are the same as the gestalt of the 1st operation.
[0162] With reference to [the gestalt of the 3rd operation] next drawing 37 , and drawing 38 , the thin film magnetic head concerning the gestalt of operation of the 3rd of this invention is explained. Drawing 37 is the sectional view showing the configuration of the thin film magnetic head concerning the gestalt of this operation. In addition, drawing 37 shows the medium opposed face and the cross section vertical to the field of a substrate. Moreover, the arrow head shown with Notation T in drawing 37 expresses the travelling direction of a record medium. Drawing 38 is the perspective view showing the important section of the thin film magnetic head shown in drawing 37 .
[0163] the gestalt of this operation -- yoke partial layer 14B -- flattening of the top face of 14B1 is carried out with the top face of the gap layer 9, and these form the 1st layer of the same flat surface. the gestalt of this operation -- this -- flattening was carried out -- magnetic pole partial layer 14A is formed on 14B1 and the gap layer 9, and the 1st layer of a non-magnetic layer 15 is further formed on it. With the gestalt of this operation, the part of an opposite hand is prolonged to the 1st magnetic layer 8 and the location which separated the 1st layer from the medium opposed face ABS rather than the magnetic connection section of 14B1 with the medium opposed face ABS of magnetic pole partial layer 14A and a non-magnetic layer 15.
[0164] Moreover, the part of an opposite hand is prolonged [ opposed face / ABS / of 2nd layer 14 B-2s of yoke partial layer 14B / medium ] to the location near the edge of an opposite hand with the medium opposed face ABS of magnetic pole partial layer 14A and a non-magnetic layer 15. With the gestalt of this operation, to magnetic pole partial layer 14A, 2nd layer 14 B-2s did not touch, but have touched only in the both-sides side of the cross direction by the back end section. In addition, 2nd layer 14 B-2s are magnetically connected to the top face of magnetic pole partial layer 14A through the non-magnetic layer 15. Therefore, in the field by the side of the gap layer 9 of magnetic pole partial layer 14A, and the crosswise both-sides side, to magnetic pole partial layer 14A, it touches, and connects magnetically and yoke partial layer 14B is directly connected magnetically to the top face of magnetic pole partial layer 14A with the gestalt of this operation through the non-magnetic layer 15.
[0165] The manufacture approach of the thin film magnetic head concerning the gestalt of this operation is the same as that of the gestalt of the 1st operation.
[0166] In addition, the up shielding layer 6 and a non-magnetic layer 7 are excluded, and you may make it the 1st magnetic layer 8 serve as the up shielding layer 6 also in the gestalt of this operation like the thin film magnetic head shown in drawing 6 . The configuration of others in the gestalt of this operation, an operation, and effectiveness are the same as the gestalt of the 1st operation.
[0167] With reference to [the gestalt of the 4th operation] next drawing 39 thru/or drawing 41 , the thin film magnetic head concerning the gestalt of operation of the 4th of this invention is explained. Drawing 39 is the sectional view showing the configuration of the thin film magnetic head concerning the gestalt of this operation. In addition, drawing 39 shows the medium opposed face and the cross section vertical to the field of a substrate. Moreover, the arrow head shown with Notation T in drawing 39 expresses the travelling direction of a record medium. Drawing 40 is the perspective view showing the important section of the thin film magnetic head shown in drawing 39 . Drawing 4141 is a perspective view showing the important section of the modification of the thin film magnetic head shown in drawing 39 . In addition, in drawing 40 and drawing 41 , the gap layer 9 and the thin film coil 10 are omitted.
[0168] The thin film magnetic head concerning the gestalt of this operation has the composition of having excluded 2nd layer 14 B-2s of yoke partial layer 14B in the gestalt of the 2nd operation. That is, yoke partial layer 14B in the gestalt of this operation is making the configuration as 14B1 of yoke partial layer 14B in the gestalt of the 2nd operation with the 1st same layer. With the gestalt of this operation, therefore, yoke partial layer 14B In the field by the side of the gap layer 9 of magnetic pole partial layer 14A, it connects magnetically to magnetic pole partial layer 14A. A part of yoke partial layer 14B and magnetic pole partial layer 14A [ at least ] for a connection It is arranged in the location by the side of the medium opposed face ABS rather than a part for the connection of the 1st magnetic layer 8 and yoke partial layer 14B.
[0169] The manufacture approach of the thin film magnetic head concerning the gestalt of this operation becomes what skipped the process which forms 2nd layer 14 B-2s in the gestalt of the 2nd operation.

[0170] With the gestalt of this operation, the part which does not touch magnetic pole partial layer 14A among the fields of an opposite hand is arranged in the 1st magnetic layer 8 of yoke partial layer 14B at the 1st magnetic layer 8 side rather than the field by the side of the gap layer 9 of magnetic pole partial layer 14A. Moreover, in the 1st magnetic layer 8 of yoke partial layer 14B, it is approaching the 1st magnetic layer 8 gradually as a part of field [ at least ] of an opposite hand separates from magnetic pole partial layer 14A. The configuration of the field of an opposite hand is determined by etching at the time of forming magnetic pole partial layer 14A in the 1st magnetic layer 8 of such yoke partial layer 14B.
[0171] In addition, drawing 40 shows the case where yoke partial layer 14B is made into the configuration as 14B1 of yoke partial layer 14B in the gestalt of the 2nd operation with the 1st same layer. On the other hand, the case where made drawing 41 larger than the gestalt of the 2nd operation of the thickness of insulating-layer 9B, and thickness in the part by the side of the medium opposed face ABS of yoke partial layer 14B is made thinner than the case of drawing 40 is shown.
[0172] With the gestalt of this operation, it becomes possible to connect magnetically magnetic pole partial layer 14A and the 1st magnetic layer 8 in a short distance by yoke partial layer 14B, without enlarging the volume of yoke partial layer 14B superfluously by having made yoke partial layer 14B into the above configurations.
[0173] Moreover, with the gestalt of this operation, since yoke partial layer 14B consists of one layer, compared with the gestalt of other operations, the structure of the thin film magnetic head and manufacture become easy.
[0174] In addition, the up shielding layer 6 and a non-magnetic layer 7 are excluded, and you may make it the 1st magnetic layer 8 serve as the up shielding layer 6 also in the gestalt of this operation like the thin film magnetic head shown in drawing 6 . The configuration of others in the gestalt of this operation, an operation, and effectiveness are the same as the gestalt of the 2nd operation.
[0175] In addition, this invention is not limited to the gestalt of each above-mentioned implementation, but various modification is possible for it. For example, in drawing 1 , although the 1st layer of the edge by the side of the medium opposed face ABS of 2nd layer 14 B-2s of yoke partial layer 14B is arranged near the medium opposed face ABS rather than the edge by the side of the medium opposed face ABS of 14B1, reverse is sufficient as this and the physical relationship of both ends may be arranged in the location of distance with both ends equal from the medium opposed face ABS.
[0176] Moreover, a non-magnetic layer is formed on an etched layer after the process which forms an etched layer. The approach of forming the mask corresponding to the configuration of a magnetic pole partial layer, etching a non-magnetic layer and an etched layer using this mask, and determining the appearance of a magnetic pole partial layer on this non-magnetic layer The gap layer of not only the thin film magnetic head of this invention but a magnetic pole partial layer is effective also in the thin film magnetic head of other configurations, if it is the desirable thin film magnetic head to maintain the surface smoothness of the edge of an opposite hand.
[0177]
[Effect of the Invention] As explained above, in the thin film magnetic head according to claim 1 to 22 The 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer, and the yoke partial layer is magnetically connected to the magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and the crosswise both-sides side at least. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since the yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to the magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and the crosswise both-sides side at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. according to this invention from these things -- electromagnetism -- the effectiveness of becoming possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property is done so.
[0178] Moreover, since according to the thin film magnetic head according to claim 2 the 1st magnetic layer is arranged at the backside [ the travelling direction of a record medium ] and the 2nd magnetic layer is

arranged at a before [ the travelling direction of a record medium ] side, in a record medium, the magnetization pattern of high density can be formed more, consequently the effectiveness that track recording density can be raised is done so.
[0179] Moreover, the 1st layer to which according to the thin film magnetic head according to claim 3 or 4 the yoke partial layer touched the field by the side of the gap layer of the 1st magnetic layer and a magnetic pole partial layer, and was magnetically connected to these, The both-sides side of the cross direction of the 1st layer and a magnetic pole partial layer is touched, and since it was made for the 2nd layer magnetically connected to these to be included, the effectiveness that formation of a yoke partial layer becomes easy is done so.
[0180] moreover -- since the layer [ 2nd ] yoke partial layer is further connected with the gap layer of a magnetic pole partial layer magnetically in the field of an opposite hand according to the thin film magnetic head according to claim 4 -- the gap layer of a magnetic pole partial layer -- from the field of an opposite hand -- the magnetic pole partial layer from a layer [ 2nd ] yoke partial layer -- magnetic flux -- it can lead -- electromagnetism -- the effectiveness that conversion efficiency improves is done so.
[0181] Moreover, according to the thin film magnetic head according to claim 5 to 7, further, since it connects with the medium opposed face of a magnetic pole partial layer magnetically to the magnetic pole partial layer in the end face of an opposite hand, a yoke partial layer does so the effectiveness that the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented further.
[0182] Moreover, the 1st layer to which according to the thin film magnetic head according to claim 6 or 7 the yoke partial layer touched the field by the side of the gap layer of the 1st magnetic layer and a magnetic pole partial layer, and was magnetically connected to these, The medium opposed face of the 1st layer and a magnetic pole partial layer touches the end face of an opposite hand, and a crosswise both-sides side, and since it was made to contain the 2nd layer magnetically connected to these, it does so the effectiveness that formation of a yoke partial layer becomes easy.
[0183] moreover -- since the layer [ 2nd ] yoke partial layer is further connected with the gap layer of a magnetic pole partial layer magnetically in the field of an opposite hand according to the thin film magnetic head according to claim 7 -- the gap layer of a magnetic pole partial layer -- from the field of an opposite hand -- the magnetic pole partial layer from a layer [ 2nd ] yoke partial layer -- magnetic flux -- it can lead -- electromagnetism -- the effectiveness that conversion efficiency improves is done so.
[0184] Moreover, according to the thin film magnetic head according to claim 8, since it is arranged in the location distant from the medium opposed face, the edge by the side of the medium opposed face of a yoke partial layer does so the effectiveness that it can prevent that informational writing arises in a record medium by the field generated from the edge by the side of the medium opposed face of a yoke partial layer.

[0185] Moreover, since the width of face of the part which touches the yoke partial layer of a magnetic pole partial layer is larger than the width of face in the medium opposed face of a magnetic pole partial layer according to the thin film magnetic head according to claim 9 By being able to prevent the saturation of the magnetic flux in the part which touches the yoke partial layer of a magnetic pole partial layer, and being able to lead magnetic flux to a magnetic pole partial layer from a yoke partial layer efficiently, and making small exposure area in the medium opposed face of a magnetic pole partial layer The effectiveness that the field impressed to a record medium can be enlarged is done so.
[0186] Moreover, without according to the thin film magnetic head according to claim 10, enlarging the thickness and width of face of a magnetic pole partial layer, since the die length to the end face of an opposite hand was set to 2 micrometers or more with the medium opposed face of a magnetic pole partial layer from the medium opposed face, the saturation of the magnetic flux in the part which touches the yoke partial layer of a magnetic pole partial layer is prevented, and the effectiveness that magnetic flux can be efficiently led to a magnetic pole partial layer from a yoke partial layer is done so.
[0187] Moreover, since it had the non-magnetic layer which touches the gap layer of a magnetic pole partial layer in the field of an opposite hand according to the thin film magnetic head according to claim 11 to 14, when forming a magnetic pole partial layer by dry etching, or in case a yoke partial layer is formed with electroplating, with the gap layer of a magnetic pole partial layer, the field of an opposite hand can prevent receiving a damage and does so the effectiveness that the field can be made flat.
[0188] Moreover, since the non-magnetic layer is exposed to a medium opposed face according to the thin film magnetic head according to claim 12 In a medium opposed face, the edge of an opposite hand is kept flat with the gap layer of a magnetic pole partial layer. The field generated from a magnetic pole partial layer in a medium opposed face can be equalized about the direction which intersects a truck, consequently

distortion of the bit pattern configuration in a record medium is suppressed, and the effectiveness that track recording density can be raised is done so.
[0189] Moreover, since according to the thin film magnetic head according to claim 13 a part of yoke partial layer adjoins the gap layer of a magnetic pole partial layer through a non-magnetic layer in the field of an opposite hand and it connects with the magnetic pole partial layer magnetically through the non-magnetic layer, with the gap layer of a magnetic pole partial layer, the effectiveness that magnetic flux can be led to a magnetic pole partial layer from a yoke partial layer through a non-magnetic layer is done so also from the field of an opposite hand.
[0190] Moreover, since a non-magnetic layer consists of an ingredient with the etch rate smaller than the ingredient which constitutes a magnetic pole partial layer, and the ingredient which constitutes the part which touches a magnetic pole partial layer among gap layers to dry etching, in case a magnetic pole partial layer is formed by dry etching according to the thin film magnetic head according to claim 14, with the gap layer of a magnetic pole partial layer, the field of an opposite hand does so the effectiveness that it can prevent receiving a damage.
[0191] Moreover, according to the thin film magnetic head according to claim 15, since some thin film coils [ at least ] are arranged in the location near [ location / of the 1st magnetic layer and the magnetic pole partial layer of the 2nd magnetic layer / middle ] the 1st magnetic layer, it does so the effectiveness that the field generated from a thin film coil is efficiently absorbable with the 1st magnetic layer.
[0192] According to the thin film magnetic head according to claim 16 to 18, moreover, a gap layer The 1st part which it consists of an ingredient which has a fluidity at the time of formation, is filled up among some [ at least ] coils of a thin film coil at least, and is not exposed to a medium opposed face, Since it has the 2nd part which consists of an ingredient excellent in corrosion resistance, rigidity, and insulation, and is exposed to a medium opposed face rather than the 1st part, it can be filled up with a non-magnetic material that there is no clearance between the coils of a thin film coil, and the effectiveness that the dependability of a gap layer can be raised is done so.
[0193] moreover -- since it had the magneto-resistive effect component as a playback component according to the thin film magnetic head according to claim 19 to 21 -- an induction type -- electromagnetism -- the effectiveness that the playback engine performance can be raised is done so compared with the case where it reproduces using a sensing element.
[0194] Moreover, according to the thin film magnetic head according to claim 22, since this thin film magnetic head was used for vertical magnetic recording, effect of heat fluctuation of a record medium is made hard to be influenced, and the effectiveness that track recording density can be raised is done so.
[0195] By the manufacture approach of the thin film magnetic head according to claim 23 to 31 The 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer, and a yoke partial layer is magnetically connected to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and a crosswise both-sides side at least. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since a yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer, and a crosswise both-sides side at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. according to this invention from these things -- electromagnetism -- the effectiveness of becoming possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property is done so.
[0196] Moreover, according to the manufacture approach of the thin film magnetic head according to claim 24, further, since it connects with the medium opposed face of a magnetic pole partial layer magnetically to a magnetic pole partial layer in the end face of an opposite hand, a yoke partial layer does so the effectiveness that the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented further.
[0197] Moreover, since according to the manufacture approach of the thin film magnetic head according to claim 25 to 31 a layer [ 2nd ] yoke partial layer is formed after forming a layer [ 1st ] yoke partial layer and

forming a magnetic pole partial layer before forming a magnetic pole partial layer The effectiveness of becoming possible to form easily the yoke partial layer magnetically connected to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer and a crosswise both-sides side at least is done so. Moreover, in this invention, on the 1st layer by which flattening was carried out, and a gap layer, the etched layer which consists of an ingredient which constitutes a magnetic pole partial layer was formed, this etched layer was selectively etched by dry etching, and the appearance of a magnetic pole partial layer is determined. Therefore, according to this invention, in a medium opposed face, flattening of the edge by the side of the gap layer of a magnetic pole partial layer can be carried out. Moreover, thereby, when forming an etched layer by the spatter, in a medium opposed face, flattening also of the edge of an opposite hand can be carried out to the gap layer of a magnetic pole partial layer. From these things, according to this invention, the field generated from a magnetic pole partial layer in a medium opposed face can be equalized about the direction which intersects a truck, consequently distortion of the bit pattern configuration in a record medium is suppressed, and the effectiveness that track recording density can be raised is done so.

[0198] Moreover, according to the manufacture approach of the thin film magnetic head according to claim 26, since the end face of an opposite hand is touched and it connects with the medium opposed face of a magnetic pole partial layer magnetically to this further, a layer [ 2nd ] yoke partial layer does so the effectiveness that the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented further.

[0199] According to the manufacture approach of the thin film magnetic head according to claim 27, moreover, after the process which forms an etched layer By polish, since it was made to carry out flattening of the top face of an etched layer, it sets to a medium opposed face. Flattening of the edge of an opposite hand can be thoroughly carried out to the gap layer of a magnetic pole partial layer. By this The field generated from a magnetic pole partial layer in a medium opposed face can be equalized about the direction which intersects a truck, consequently distortion of the bit pattern configuration in a record medium is suppressed, and the effectiveness that track recording density can be raised is done so.

[0200] According to the manufacture approach of the thin film magnetic head according to claim 28 or 29, moreover, after the process which forms an etched layer Form a non-magnetic layer on an etched layer, and the mask corresponding to the configuration of a magnetic pole partial layer is formed on this non-magnetic layer. Since a non-magnetic layer and an etched layer are etched and the appearance of a magnetic pole partial layer was determined using this mask Where the top face of an etched layer is protected by the non-magnetic layer, the appearance of a magnetic pole partial layer can be determined, and the effectiveness of becoming possible to maintain the surface smoothness of the edge of an opposite hand with the gap layer of a magnetic pole partial layer is done so.

[0201] According to the manufacture approach of the thin film magnetic head according to claim 29, moreover, the process which forms a mask Since the resist frame which has the opening section corresponding to the configuration of a magnetic pole partial layer is formed on a non-magnetic layer and the mask was formed in the opening circles of this resist frame It becomes possible to form the mask excellent in the resistance over dry etching. Consequently, even when the ingredient which constitutes a magnetic pole partial layer is excellent in the resistance over dry etching, the effectiveness of becoming possible to determine the appearance of a magnetic pole partial layer by the dry etching which used the mask is done so.

[0202] Moreover, since the layer [ 2nd ] yoke partial layer was formed with electroplating, while being able to form the 2nd layer easily according to the manufacture approach of the thin film magnetic head according to claim 30 or 31, the effectiveness of becoming possible to form the 2nd layer in the configuration where it followed well in the configuration of the substrate is done so.

[0203] According to the manufacture approach of the thin film magnetic head according to claim 31, moreover, the process which forms a layer [ 2nd ] yoke partial layer The process which forms wrap resist covering for the part by the side of the medium opposed face in a magnetic pole partial layer, Since it was made to include the process which forms the electrode layer for electroplating on the 1st layer of resist covering, a magnetic pole partial layer, and a yoke partial layer, and the process which forms a layer [ 2nd ] yoke partial layer with electroplating using an electrode layer It can prevent that an electrode layer and the affix at the time of etching remain on some side faces by the side of the medium opposed face in a magnetic pole partial layer. The effectiveness that it can prevent that the width of recording track becomes large by the residual of an electrode layer, or the dependability of the thin film magnetic head falls by the residual of the affix at the time of etching is done so.

[0204] moreover, in the thin film magnetic head according to claim 32 to 49 The 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. A yoke partial layer In the field by the side of the gap layer of a magnetic pole partial layer, it connects magnetically to the magnetic pole partial layer at least, and a part for the connection of a yoke partial layer and a magnetic pole partial layer is arranged in the location by the side of a medium opposed face rather than a part for the connection of the 1st magnetic layer and a yoke partial layer. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since the yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to the magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. according to this invention from these things -- electromagnetism -- the effectiveness of becoming possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property is done so.

[0205] According to the thin film magnetic head according to claim 33, moreover, the part which does not touch the 1st magnetic layer of a yoke partial layer with said magnetic pole partial layer among the fields of an opposite hand The effectiveness of becoming possible to connect magnetically a magnetic pole partial layer and the 1st magnetic layer in a short distance is done so, without enlarging the volume of a yoke partial layer superfluously, since it is arranged at the 1st magnetic layer side rather than the field by the side of the gap layer of a magnetic pole partial layer.

[0206] Moreover, according to the thin film magnetic head according to claim 34, the effectiveness of becoming possible to connect magnetically a magnetic pole partial layer and the 1st magnetic layer with the 1st magnetic layer of a yoke partial layer in a short distance, without enlarging the volume of a yoke partial layer superfluously since it is approaching the 1st magnetic layer gradually as a part of field [ at least ] of an opposite hand separates from a magnetic pole partial layer is done so.

[0207] Moreover, since according to the thin film magnetic head according to claim 35 the 1st magnetic layer is arranged at the backside [ the travelling direction of a record medium ] and the 2nd magnetic layer is arranged at a before [ the travelling direction of a record medium ] side, in a record medium, the magnetization pattern of high density can be formed more, consequently the effectiveness that track recording density can be raised is done so.

[0208] Moreover, according to the thin film magnetic head according to claim 36, since it is arranged in the location distant from the medium opposed face, the edge by the side of the medium opposed face of a yoke partial layer does so the effectiveness that it can prevent that informational writing arises in a record medium by the field generated from the edge by the side of the medium opposed face of a yoke partial layer.

[0209] Moreover, since the width of face of the part which touches the yoke partial layer of a magnetic pole partial layer is larger than the width of face in the medium opposed face of a magnetic pole partial layer according to the thin film magnetic head according to claim 37 By being able to prevent the saturation of the magnetic flux in the part which touches the yoke partial layer of a magnetic pole partial layer, and being able to lead magnetic flux to a magnetic pole partial layer from a yoke partial layer efficiently, and making small exposure area in the medium opposed face of a magnetic pole partial layer The effectiveness that the field impressed to a record medium can be enlarged is done so.

[0210] Moreover, without according to the thin film magnetic head according to claim 38, enlarging the thickness and width of face of a magnetic pole partial layer, since the die length to the end face of an opposite hand was set to 2 micrometers or more with the medium opposed face of a magnetic pole partial layer from the medium opposed face, the saturation of the magnetic flux in the part which touches the yoke partial layer of a magnetic pole partial layer is prevented, and the effectiveness that magnetic flux can be efficiently led to a magnetic pole partial layer from a yoke partial layer is done so.

[0211] Moreover, since it had the non-magnetic layer which touches the gap layer of a magnetic pole partial layer in the field of an opposite hand according to the thin film magnetic head according to claim 39 to 41, when forming a magnetic pole partial layer by dry etching, or in case a yoke partial layer is formed with electroplating, with the gap layer of a magnetic pole partial layer, the field of an opposite hand can prevent

receiving a damage and does so the effectiveness that the field can be made flat.
[0212] Moreover, since the non-magnetic layer is exposed to a medium opposed face according to the thin film magnetic head according to claim 40 In a medium opposed face, the edge of an opposite hand is kept flat with the gap layer of a magnetic pole partial layer. The field generated from a magnetic pole partial layer in a medium opposed face can be equalized about the direction which intersects a truck, consequently distortion of the bit in a record medium is suppressed, and the effectiveness that track recording density can be raised is done so.
[0213] Moreover, since a non-magnetic layer consists of an ingredient with the etch rate smaller than the ingredient which constitutes a magnetic pole partial layer, and the ingredient which constitutes the part which touches a magnetic pole partial layer among gap layers to dry etching, in case a magnetic pole partial layer is formed by dry etching according to the thin film magnetic head according to claim 41, with the gap layer of a magnetic pole partial layer, the field of an opposite hand does so the effectiveness that it can prevent receiving a damage.
[0214] Moreover, according to the thin film magnetic head according to claim 42, since some thin film coils [ at least ] are arranged in the location near [ location / of the 1st magnetic layer and the magnetic pole partial layer of the 2nd magnetic layer / middle ] the 1st magnetic layer, it does so the effectiveness that the field generated from a thin film coil is efficiently absorbable with the 1st magnetic layer.
[0215] According to the thin film magnetic head according to claim 43 to 45, moreover, a gap layer The 1st part which it consists of an ingredient which has a fluidity at the time of formation, is filled up among some [ at least ] coils of a thin film coil at least, and is not exposed to a medium opposed face, Since it has the 2nd part which consists of an ingredient excellent in corrosion resistance, rigidity, and insulation, and is exposed to a medium opposed face rather than the 1st part, it can be filled up with a non-magnetic material that there is no clearance between the coils of a thin film coil, and the effectiveness that the dependability of a gap layer can be raised is done so.
[0216] moreover -- since it had the magneto-resistive effect component as a playback component according to the thin film magnetic head according to claim 46 to 48 -- an induction type -- electromagnetism -- the effectiveness that the playback engine performance can be raised is done so compared with the case where it reproduces using a sensing element.
[0217] Moreover, according to the thin film magnetic head according to claim 49, since this thin film magnetic head was used for vertical magnetic recording, effect of heat fluctuation of a record medium is made hard to be influenced, and the effectiveness that track recording density can be raised is done so.
[0218] By the manufacture approach of the thin film magnetic head according to claim 50 to 54 The 2nd magnetic layer has a magnetic pole partial layer and a yoke partial layer. The field by the side of the a part of [ at least ] 2nd [ of a thin film coil ] magnetic layer It is arranged in the location by the side of the 1st magnetic layer rather than the location of the edge by the side of the 2nd [ of the gap layer in a medium opposed face ] magnetic layer. A yoke partial layer In the field by the side of the gap layer of a magnetic pole partial layer, it connects magnetically to a magnetic pole partial layer at least, and a part for the connection of a yoke partial layer and a magnetic pole partial layer is arranged in the location by the side of a medium opposed face rather than a part for the connection of the 1st magnetic layer and a yoke partial layer. Therefore, in this invention, it becomes possible for a yoke partial layer to be able to form a short magnetic path between the magnetic connection section to the 1st magnetic layer, and a magnetic pole partial layer, and to arrange a yoke partial layer near the thin film coil. Moreover, in this invention, since a yoke partial layer is magnetically connected with the saturation magnetic flux density of a magnetic pole partial layer being more than the saturation magnetic flux density of a yoke partial layer to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer at least, the saturation of the magnetic flux in the middle of the 2nd magnetic layer can be prevented. according to this invention from these things -- electromagnetism -- the effectiveness of becoming possible to raise conversion efficiency, and to enlarge the field of a direction vertical to the field of a record medium generated from a magnetic pole part, and to shorten magnetic-path length, and to raise a RF property is done so.
[0219] Moreover, since according to the manufacture approach of the thin film magnetic head according to claim 51 to 54 a yoke partial layer is formed before forming a magnetic pole partial layer, the effectiveness of becoming possible to form easily the yoke partial layer magnetically connected to a magnetic pole partial layer in the field by the side of the gap layer of a magnetic pole partial layer at least is done so. Moreover, in this invention, on the yoke partial layer by which flattening was carried out, and a gap layer, the etched layer which consists of an ingredient which constitutes a magnetic pole partial layer was formed, this etched layer was selectively etched by dry etching, and the appearance of a magnetic pole partial layer is determined.

Therefore, according to this invention, in a medium opposed face, flattening of the edge by the side of the gap layer of a magnetic pole partial layer can be carried out. Moreover, thereby, when forming an etched layer by the spatter, in a medium opposed face, flattening also of the edge of an opposite hand can be carried out to the gap layer of a magnetic pole partial layer. From these things, according to this invention, the field generated from a magnetic pole partial layer in a medium opposed face can be equalized about the direction which intersects a truck, consequently distortion of the bit in a record medium is suppressed, and the effectiveness that track recording density can be raised is done so.

[0220] According to the manufacture approach of the thin film magnetic head according to claim 52, moreover, after the process which forms an etched layer By polish, since it was made to carry out flattening of the top face of an etched layer, it sets to a medium opposed face. Flattening of the edge of an opposite hand can be thoroughly carried out to the gap layer of a magnetic pole partial layer. By this The field generated from a magnetic pole partial layer in a medium opposed face can be equalized about the direction which intersects a truck, consequently distortion of the bit in a record medium is suppressed, and the effectiveness that track recording density can be raised is done so.

[0221] According to the manufacture approach of the thin film magnetic head according to claim 53 or 54, moreover, after the process which forms an etched layer Form a non-magnetic layer on an etched layer, and the mask corresponding to the configuration of a magnetic pole partial layer is formed on this non-magnetic layer. Since a non-magnetic layer and an etched layer are etched and the appearance of a magnetic pole partial layer was determined using this mask Where the top face of an etched layer is protected by the non-magnetic layer, the appearance of a magnetic pole partial layer can be determined, and the effectiveness of becoming possible to maintain the surface smoothness of the edge of an opposite hand with the gap layer of a magnetic pole partial layer is done so.

[0222] According to the manufacture approach of the thin film magnetic head according to claim 54, moreover, the process which forms a mask Since the resist frame which has the opening section corresponding to the configuration of a magnetic pole partial layer is formed on a non-magnetic layer and the mask was formed in the opening circles of this resist frame It becomes possible to form the mask excellent in the resistance over dry etching. Consequently, even when the ingredient which constitutes a magnetic pole partial layer is excellent in the resistance over dry etching, the effectiveness of becoming possible to determine the appearance of a magnetic pole partial layer by the dry etching which used the mask is done so.

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[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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DRAWINGS

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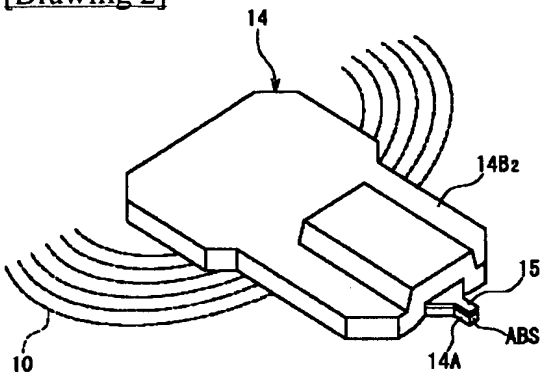
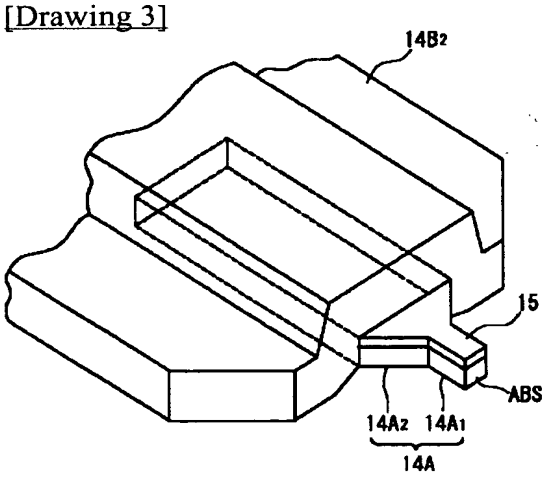
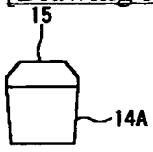
[Drawing 2]



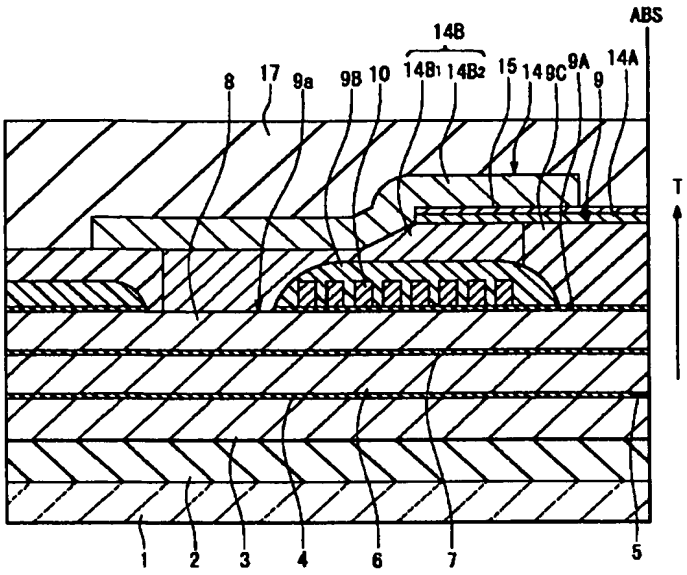

[Drawing 3]



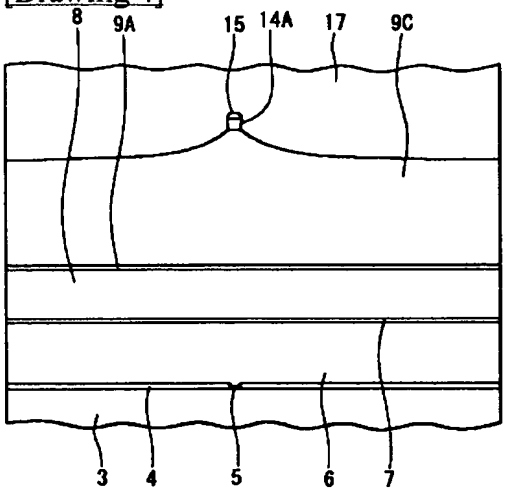

[Drawing 5]



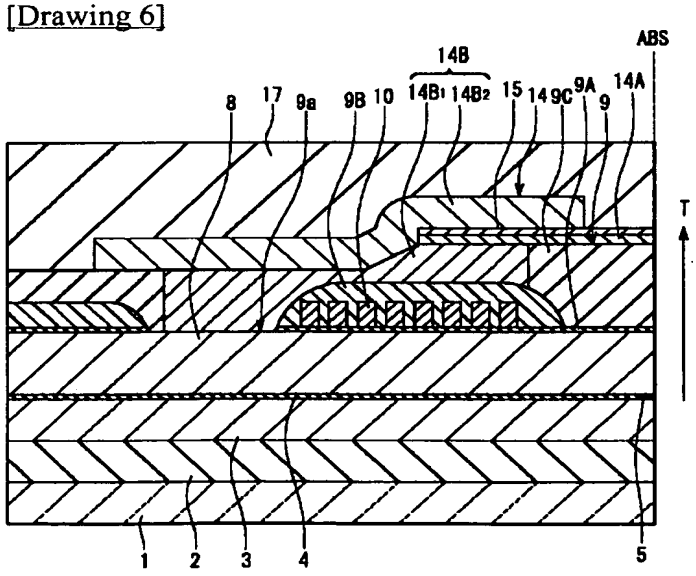

[Drawing 1]



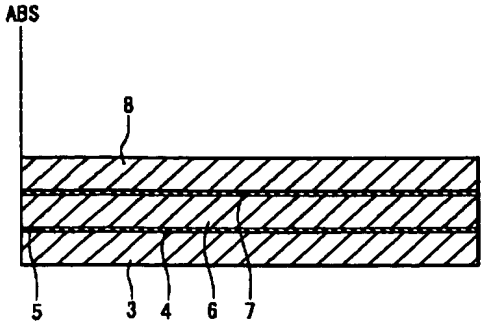

[Drawing 4]



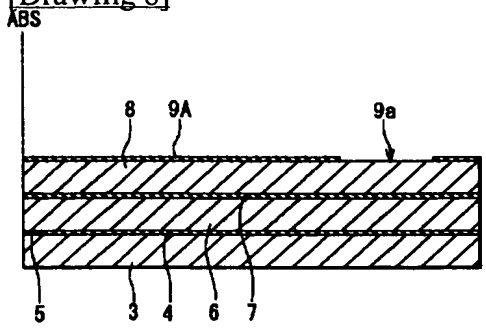

[Drawing 6]



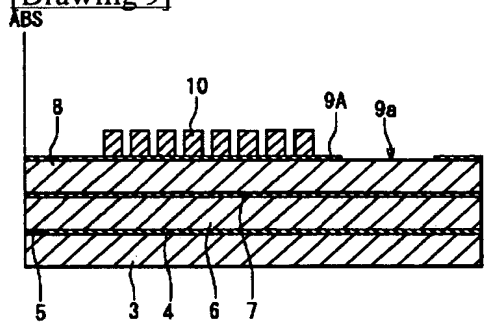

[Drawing 7]



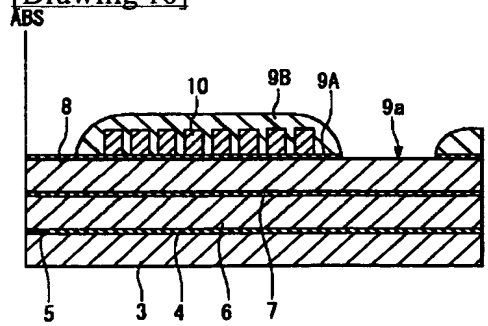

[Drawing 8]



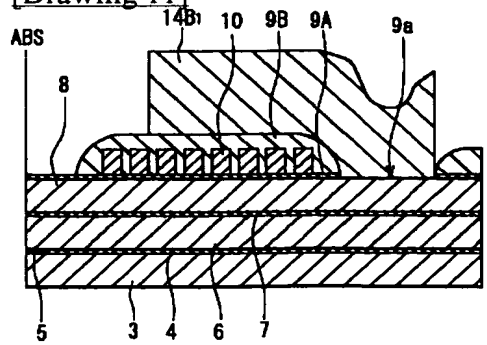

[Drawing 9]



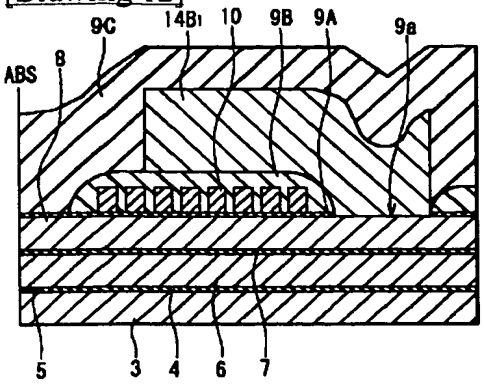

[Drawing 10]



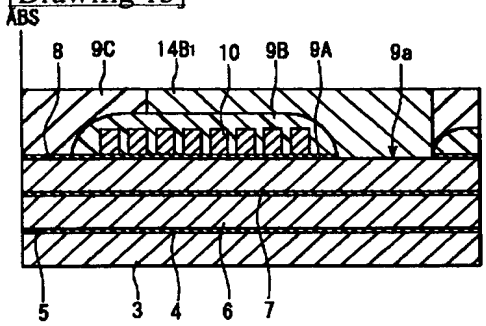

[Drawing 11]



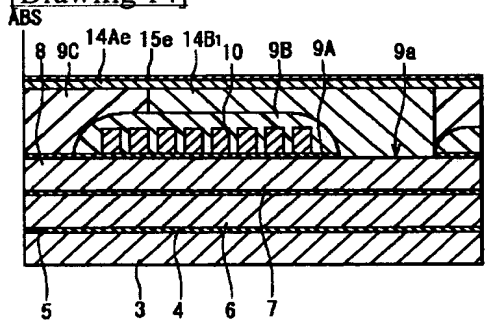
[Drawing 12]



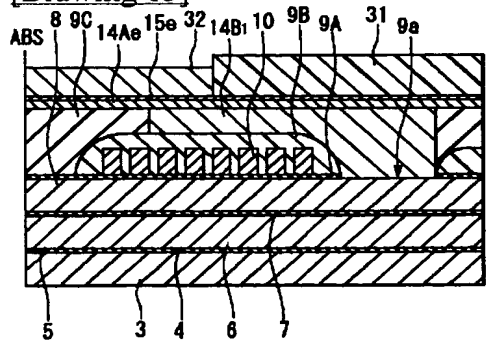

[Drawing 13]



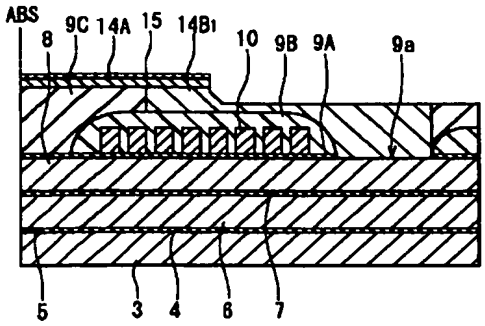

[Drawing 14]



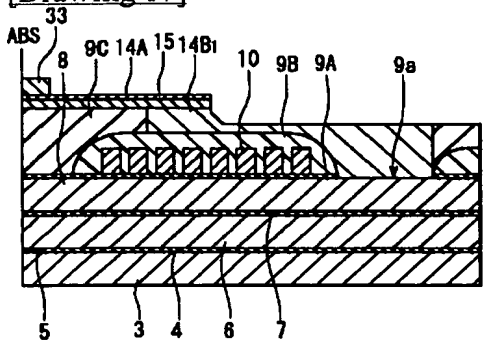

[Drawing 15]



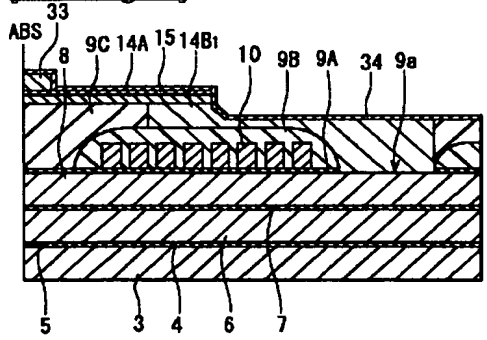

[Drawing 16]



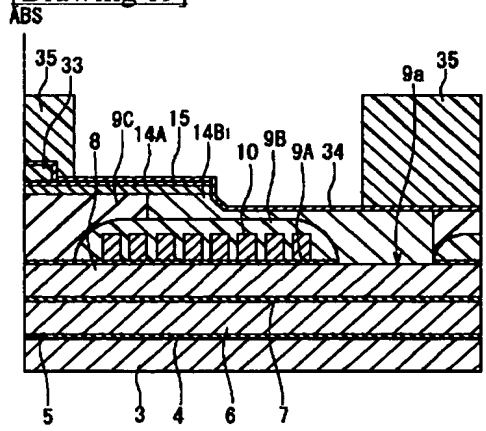

[Drawing 17]



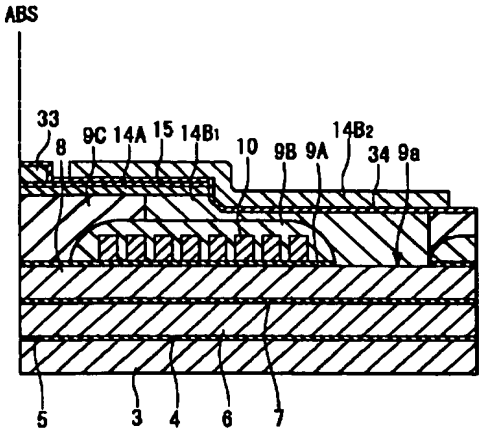

[Drawing 18]



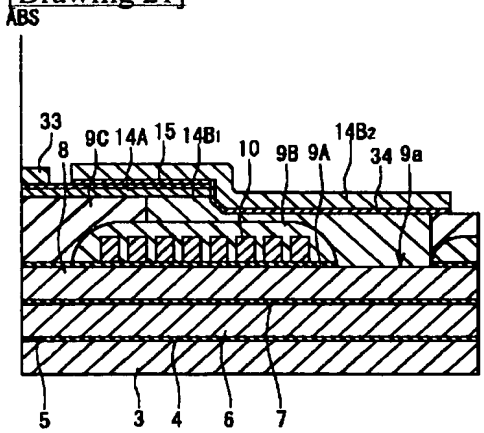

[Drawing 19]



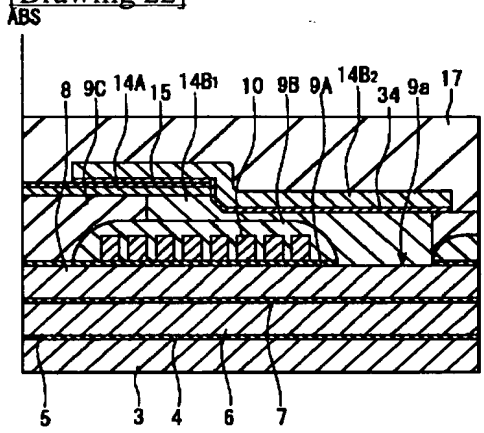

[Drawing 20]



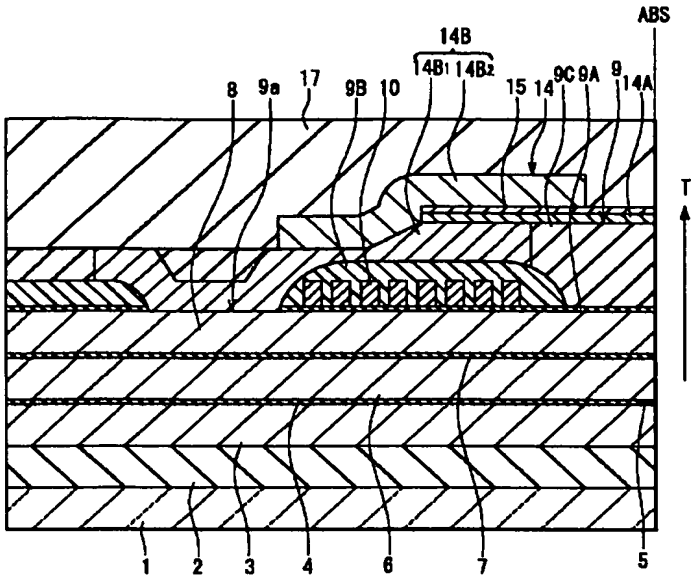

[Drawing 21]



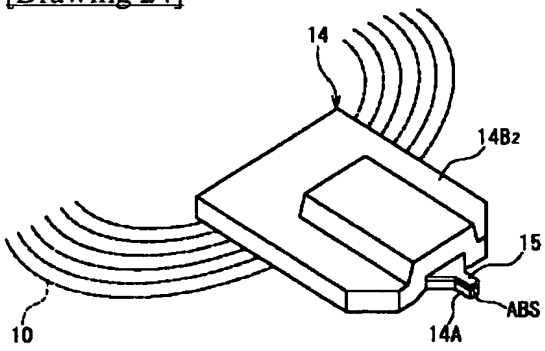

[Drawing 22]



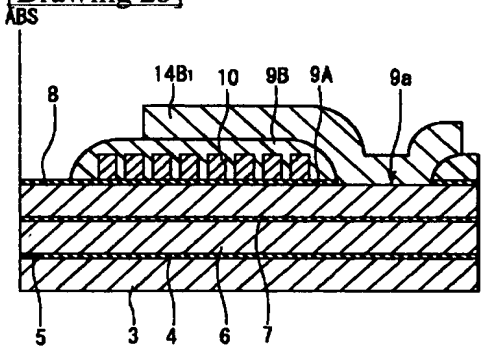

[Drawing 23]



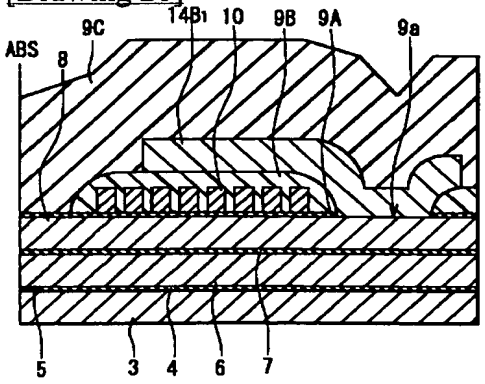

[Drawing 24]



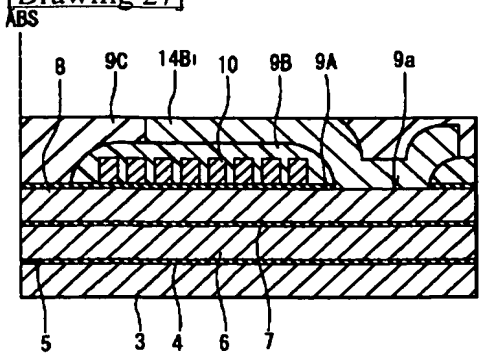

[Drawing 25]



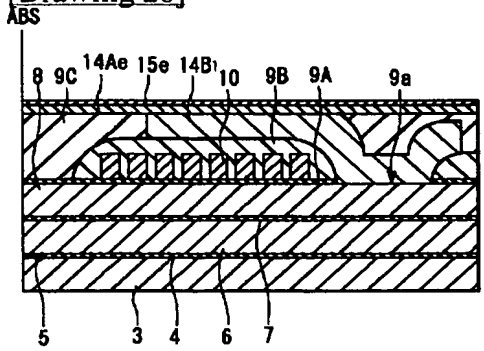

[Drawing 26]



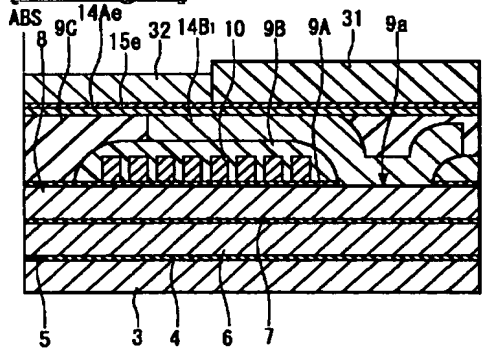
[Drawing 27]



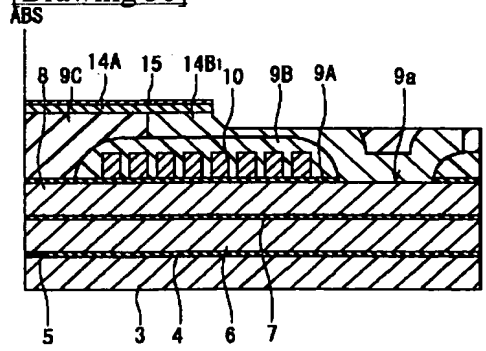

[Drawing 28]



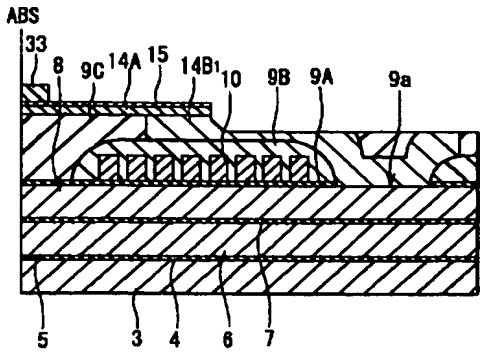

[Drawing 29]



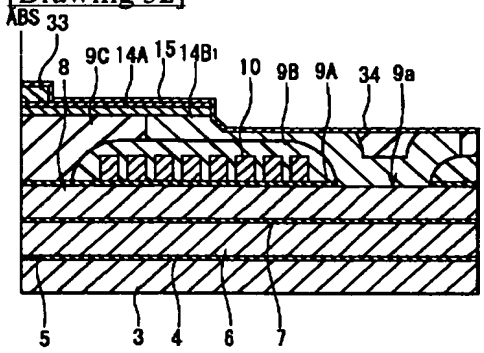

[Drawing 30]



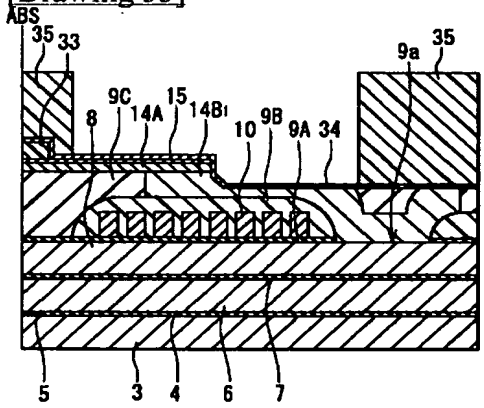

[Drawing 31]



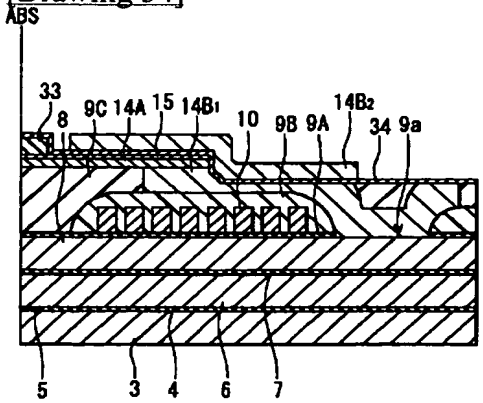

[Drawing 32]



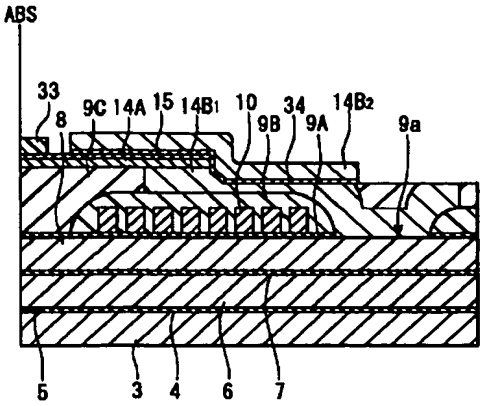

[Drawing 33]



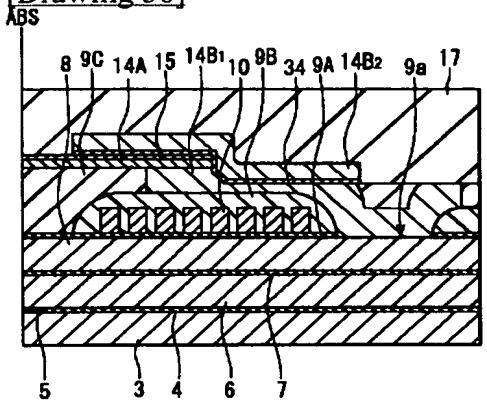

[Drawing 34]



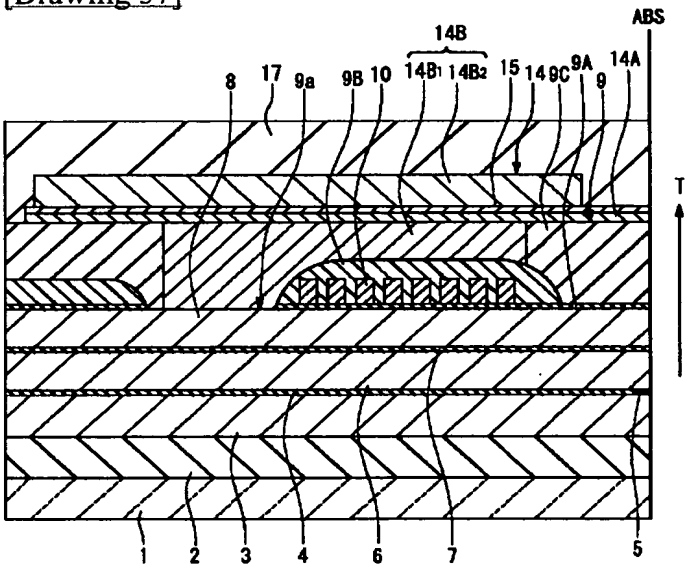

[Drawing 35]



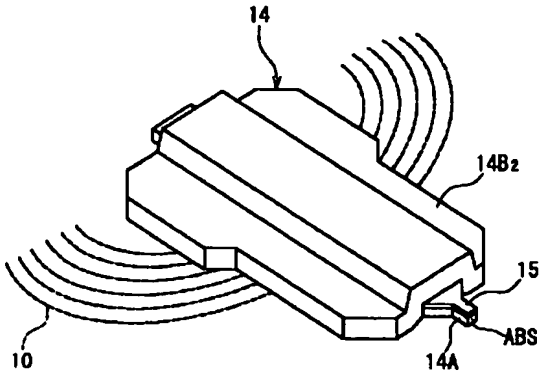

[Drawing 36]



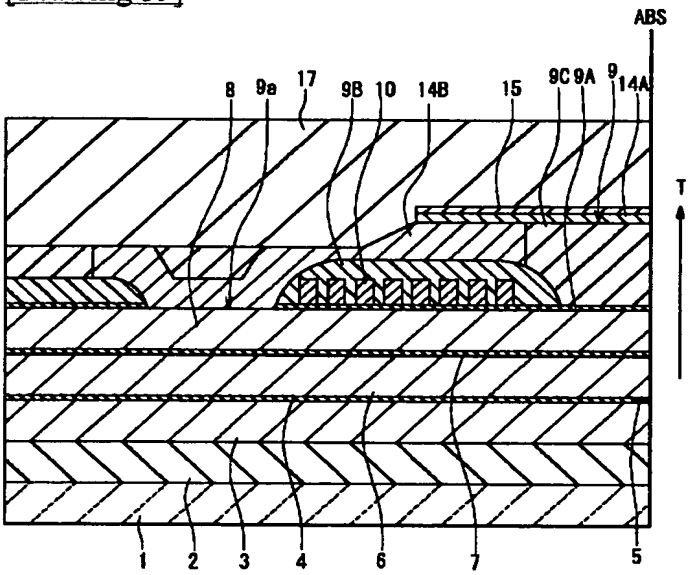

[Drawing 37]



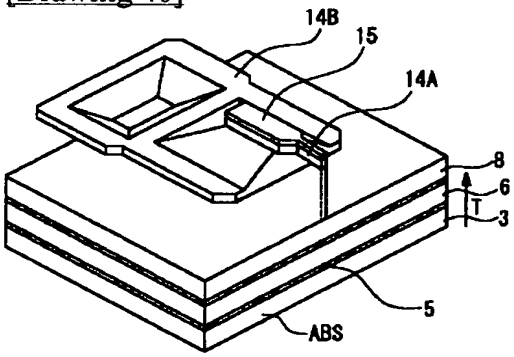

[Drawing 38]



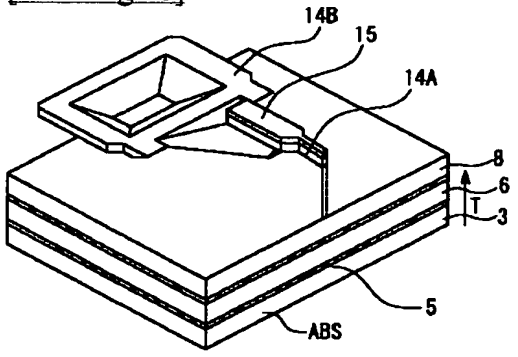

[Drawing 39]




[Drawing 40]




[Drawing 41]



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[Translation done.]